DINAMAP™
Portable Adult/Pediatric and Neonatal Vital Signs Monitor

Model 8100T

Service Manual

CRITIKON

a Johnson & Johnson company

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Patent Pending

CAUTION: Federal (U.S.A.) law restricts this device to sale by or on the order of a health care practitioner.

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WARRANTY

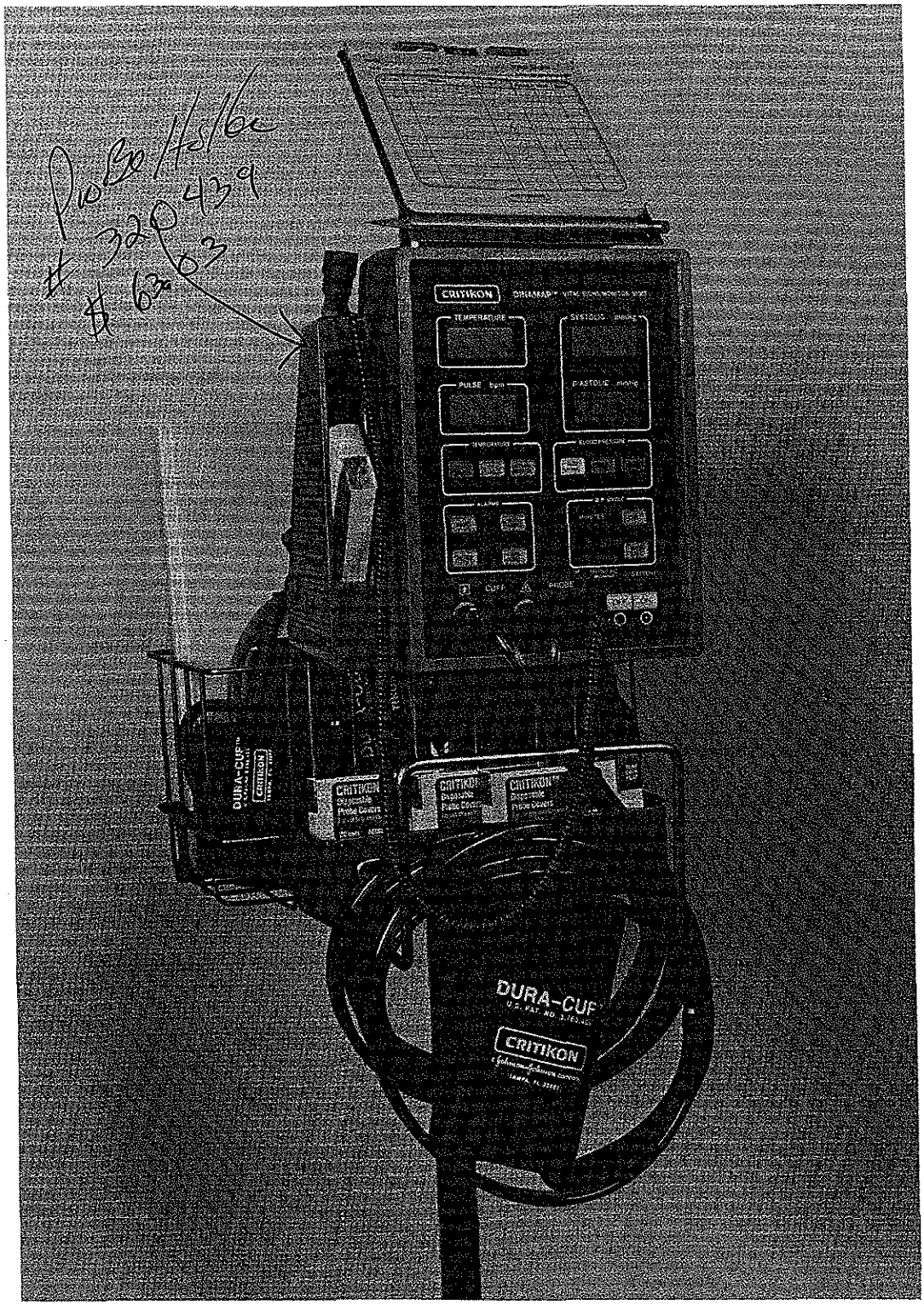
CRITIKON, INC. ("Critikon") warrants to the purchaser that the DINAMAP™ Vital Signs Monitor, exclusive of expendable parts and other accessories, shall be free from defects in material and workmanship for a period of one year from the date of purchase. Critikon's sole obligation with respect to any such defect is limited to the repair with new or remanufactured parts, or at Critikon's option, replacement of the DINAMAP™ Vital Signs Monitor, or refund of the purchase price.

This warranty is made on the condition that prompt notification of a defect is given to Critikon within the warranty period. Critikon shall have the sole right to determine whether a defect exists.

This warranty extends to the original purchaser only. This warranty does not apply to a DINAMAP™ Vital Signs Monitor that has been altered, subjected to misuse, negligence, unauthorized repair, or accident, or operated other than in accordance with the instructions.

This warranty represents the exclusive obligation of Critikon and the exclusive remedy of the purchaser regarding defects in a DINAMAP™ Vital Signs Monitor. THIS WARRANTY IS GIVEN IN LIEU OF ANY EXPRESSED OR IMPLIED WARRANTIES, INCLUDING THE WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, WHICH WARRANTIES ARE DISCLAIMED. NO PERSON IS AUTHORIZED TO MODIFY, IN ANY MANNER, CRITIKON'S OBLIGATION DESCRIBED ABOVE.

Critikon shall not, in any case, be liable for special, incidental or consequential damages arising from breach of warranty, breach of contract, negligence or any other legal theory.



DINAMAP™ Portable Vital Signs Monitor, Model 8100T

SECTION 1. INTRODUCTION

1.1 SCOPE OF MANUAL

This manual is intended for use by qualified personnel who are familiar with electromechanical devices and, in particular, solid state digital and analog circuit techniques. The manual can be used as a learning device for those persons interested in the principles of operation of the Model 8100T Vital Signs Monitor; however, if the manual is to be used as a reference document and service guide for personnel assigned to calibrate, adjust, troubleshoot or repair the unit, the equipment listed in Table 5-3 must be available for use.

WARNING
To avoid personal injury, the user should not perform any servicing unless qualified to do so.

There are six sections in this manual:

- Section 1 describes this manual and tells how to use it, describes the methods used to change or update the manual, lists the related publications pertaining to the Model 8100T and its accessories, and presents Critikon's service policy.
- Section 2 identifies, by Critikon reorder number, all models covered by this manual including optional equipment and accessories. It provides a physical and functional description of the equipment and a complete list of specifications.
- Section 3 presents installation and operating procedures and remote computer command and control.
- Section 4 presents the principles of operation to a level sufficient to facilitate troubleshooting and repair to the component level.
- Section 5 provides procedures for both preventive and corrective maintenance. Preventive maintenance procedures include cleaning, performance checks, calibration procedures, alignments and adjustments. Corrective maintenance procedures include use of internal diagnostic programs and alarm codes for troubleshooting purposes.
- Section 6 contains all the service diagrams in order of reference within the manual text with illustrated parts breakdown drawings and related parts lists provided at the end of the section.

1.2 RELATED PUBLICATIONS

An operation manual (Critikon Part Number 776-399) is supplied with each unit as part of the accessory kit.

1.3 MANUAL CHANGES

If in the normal use of this manual, errors, omissions, or incorrect data are noted, please complete the Publications Change Request Form in the back of this manual. Submit the form to:

Critikon, Inc.
Marketing Services
4110 George Road
Tampa, Florida 33634

Changes to this manual, either in response to user inputs or to continuing product improvements, will be accomplished through reprinting. Changes occurring between printings will be addressed through change information sheets and replacement pages. If a change information sheet does not accompany your manual, it is correct as printed.

1.4 SERVICE POLICY

All repairs on products under warranty must be performed by Critikon personnel. *Unauthorized repairs will void the warranty.* Products out of warranty should be repaired by qualified electronics personnel.

1.4.1 Technical Assistance

If the monitor fails to function properly or requires maintenance, contact the Critikon Sales Representative or call your regional Critikon Service Center (See Critikon Service Information page at the end of this manual).

1.4.2 Repair Service

To obtain repair service, contact your regional Critikon Service Center. State your:

- hospital name
- address
- telephone number
- serial number, and
- the nature of the problem.

Critikon's Field Service Representative will advise you of the corrective action required. If you are advised to return the monitor to Critikon for repair, do the following:

1. Package the monitor with adequate protection. If available, use the original materials in which the monitor was shipped.

2. Include a brief description of the problem as well as the name, address, and phone number of the person to be contacted for additional information.

3. Include a purchase order number if the monitor being returned is out of warranty.

1.4.2
Repair Service
Continued

4. Ship the monitor, transportation prepaid, to the location specified by your Critikon Field Service Representative. Repairs will be made at the appropriate service facility and the monitor will be returned to the purchaser prepaid.

1.4.3
Repair Parts

To obtain information on or order repair parts call Critikon Customer Service at 1-800-237-6393; in Florida, call 1-800-282-9151.

SECTION 2. PRODUCT DESCRIPTION

2.1 GENERAL DESCRIPTION

The DINAMAP™ Portable Vital Signs Monitor, Model 8100T is designed to noninvasively and automatically measure systolic and diastolic pressure, and pulse rate for neonatal or adult/pediatric patients. Results are displayed on large, easy-to-read digital displays.

The DINAMAP™ Portable Vital Signs Monitor, Model 8100T is a microprocessor-controlled, battery-powered or AC line-powered, portable monitor. The monitor will cycle automatically at operator programmed intervals between one and ninety minutes. Results of the last determination will remain displayed (up to ninety minutes) until another determination is completed.

The DINAMAP™ Portable Vital Signs Monitor, Model 8100T integrates into the standard blood pressure monitoring device a patient temperature probe, temperature display, connecting port, and operation keys. Temperature determinations and blood pressure determinations are independent and may be taken simultaneously. Mean arterial pressure (MAP) values, although not displayed, are measured during blood pressure determinations and are available (as data) through the rear panel data interface port.

The DINAMAP™ Portable Vital Signs Monitor, Model 8100T is designed to meet the specific needs of monitoring vital signs in the Medical/Surgical Units. The monitor may be ordered in several different language models which provide internal battery chargers operating at various line voltages. Each monitor is shipped with an accessory kit containing an operation manual, an AC line cord, a calibration kit, two temperature probes with probe covers, two pneumatic hoses (adult and neonate) and a variety of cuffs.

2.1.1 Product Reorder Numbers

To provide for operation from various voltage sources in a number of different countries, the following Critikon product reorder codes have been assigned to the Model 8100T DINAMAP™ Vital Signs Monitor:

PRODUCT DESCRIPTION	REORDER NO.
DINAMAP™ Monitor, 120 Vac, 60 Hz, Domestic	8110
DINAMAP™ Monitor, 240 Vac, 50 Hz, English	8111
DINAMAP™ Monitor, 220 Vac, 50 Hz, French	8113
DINAMAP™ Monitor, 100 Vac, 50 Hz, Japanese	8114

2.1.2 Accessory Reorder Numbers

Table 2-1 lists the accessories that have been designated for use with the Model 8100T DINAMAP™ Vital Signs Monitor and are identified by reorder number and part number where applicable.

TABLE 2-1. MODEL 8100T ACCESSORIES

PRODUCT DESCRIPTION	SALES DEPT. REORDER NO.	FIELD SERV. PART NO.
Model 8100T Operation Manual *	NA	776-399
Bladderless Blood Press. Cuff, Adult *	2774	n/a
Bladderless Blood Press. Cuff, Sm. Adult	2779	n/a
Bladderless Blood Press. Cuff, Child	2781	n/a
Bladderless Blood Press. Cuff, Infant	2783	n/a
Bladderless Blood Press. Cuff, Lg. Adult	2791	n/a
Bladderless Blood Pressure Cuff, Thigh	2796	n/a
Hose Assembly, 12 foot *	8841	n/a
Hose Assembly, 24 foot	8842	n/a
Hose Assembly, 8 foot (neonatal) *	8840	n/a
Disp. Blood Press. Cuff, Neo. #1 (sterile)	8311(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #2 (sterile)	8312(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #3 (sterile)	8313(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #4 (sterile)	8314(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #1 (non-sterile)	2638(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #2 (non-sterile)	2633(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #3 (non-sterile)	2628(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #4 (non-sterile)	2623(10/case)	n/a
Disp. Blood Press. Cuff, Neo. #5 (non-sterile)*	2619(10/case)	n/a
Disp. Blood Press. Cuff, Lg. Adult (non-ster.)	2643	n/a
Disp. Blood Press. Cuff, Adult (non-sterile)	2603	n/a
Disp. Blood Press. Cuff, Sm. Adult (non-ster.)	2608	n/a
Disp. Blood Press. Cuff, Thigh (non-sterile)	2648	n/a
Disp. Blood Press. Cuff, Child (non-sterile)	2613	n/a
Disp. Blood Press. Cuff, Infant (non-sterile)	2618	n/a
Disp. Blood Press. Cuff,Lg. Adult (infect. ctl.)	2642	n/a
Disp. Blood Press. Cuff,Adult (infect. ctl.)	2602	n/a
Disp. Blood Press. Cuff,Sm. Adult (infect. ctl.)	2607	n/a
Calibration Kit*	8886	320-246
Power Cord, Domestic*	8884	316-159
Power Cord, International*	8885	320-193
DINAMAP™ Monitor Pole*	3207	n/a
DINAMAP™ Monitor Stand*	3208	n/a
Accessory Basket with Tray*	3209	n/a
Writing Tablet Holder*	8812	n/a
Writing Tablets (5)*	8811(25/case)	n/a

* Indicates that one of each of these items is shipped with the DINAMAP™ Monitor.

2.1.2 Accessory Reorder Numbers Continued

TABLE 2-1. MODEL 8100T ACCESSORIES Cont.

PRODUCT DESCRIPTION	SALES DEPT. REORDER NO.	FIELD SERV. PART NO.
Temperature Probe, Rectal (red)*	8813	n/a
Temperature Probe, Oral (blue)*	8814	n/a
Temperature Probe covers (100)*	8815(5000/case)	n/a
Temperature Calibration Plug*	n/a	320-438
RS232 Interface Adaptor Kit	8801	n/a
Extender Cable, Pneum.-to-CPU	n/a	300-578
Extender Cable, Power Supply-to-CPU	n/a	300-579
Extender Cable, Keyboard-to-CPU	n/a	300-580
Extender Cable, Display-to-CPU	n/a	300-581

* Indicates that one of each of these items is shipped with the DINAMAP™ Monitor.

2.2 PHYSICAL DESCRIPTION

The Model 8100T DINAMAP™ Vital Signs Monitor is housed in a blue plastic impact resistant case measuring 8.8 inches high, 6.7 inches wide and 6.7 inches deep. It is equipped with a molded-in carrying handle and an integral pole clamp. Four rubber feet are attached to the bottom of the unit for stability on a horizontal surface. Provided with the monitor are:

- mobile pole and stand;
- accessory basket for holding cuffs and hoses;
- tablet holder and writing tablets;
- and a temperature probe holder which attaches to the side of the monitor and holds the two temperature probes (oral and rectal) and a box of probe covers.

The unit is battery powered by an internal 12 volt, lead-acid battery which is accessed through a removable door on the rear of the unit to allow easy replacement. The battery should last at least two years under normal operating conditions. An internal battery charger allows the battery to be charged and the unit to be powered from an AC supply through a detachable 10 foot cord.

All controls and indicators (except the AC power switch on British units) are situated on the front panel. The LED indicators and the membrane switches are protected by a polycarbonate film which allows easy cleaning of the unit and protects the electronics from contamination. The pneumatic hose is attached to screw-on type stainless steel connectors at the front panel. The pneumatic hoses are available in two lengths (12 and 24 feet) for adult/pediatric patients and one 8 foot length for neonatal patients.

TABLE 2-2. MODEL 8100T FRONT PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
7	**AUTO/ MANUAL** Cont.	In the blood pressure auto mode, one determination is initiated immediately. Subsequent determinations occur at the end of the cycle time shown in the **CYCLE MINUTES** display (Item 11). Determinations may be initiated at any time by pressing the **START** switch (during wait time). The cycle timer starts when auto mode is first entered and restarts at the beginning of each automatic or manually started blood pressure determination.
8	**CANCEL**	This red membrane switch performs several functions. Pressing the switch will: 1) terminate a blood pressure determination in process; 2) cancel all visual and audible blood pressure alarms (except 900 series or failsafe alarms); 3) exit the calibrate mode of operation; 4) exit the patient alarm limits set routine; and 5) exit the display of prior data.
9	**START**	This green membrane switch initiates a blood pressure determination. In auto mode, pressing this switch will override the cycle timer and initiate a new determination.
10	**SET**	This gray membrane switch increments the **CYCLE MINUTES** display when in auto mode. The default **CYCLE MINUTES** value is 3 minutes. Pressing the set switch will change this to 1 and then increment the setting to 2, 3, 4, 5,10, 15, 20, 30, 45, 60, 90 and then wrap around to repeat the sequence. Holding the **SET** switch in for 4 seconds while momentarily pressing the **ON** switch places the monitor in calibrate mode, where it will remain for 3 minutes. Holding the **SET** switch for 20 seconds while momentarily pressing the **ON** switch will cause the monitor to remain in calibrate mode indefinitely.

TABLE 2-2. MODEL 8100T FRONT PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
11	**CYCLE MINUTES**	This seven-segment, two-digit, red LED display shows the blood pressure cycle time, in minutes, when the monitor is placed in **AUTO** mode. When **AUTO** mode is first entered the cycle time shown is 3. The cycle time may be changed by pressing the **SET** switch. In addition to this basic function the **CYCLE MINUTES** display will flash, every four seconds, showing the elapsed time in minutes since the last blood pressure determination was made. This is done in **AUTO** or **MANUAL** modes.
12	**PRIOR DATA**	Pressing this gray switch will cause the monitor to display the results of previous determinations in the **TEMPERATURE, SYSTOLIC, DIASTOLIC** and **PULSE** displays. The number of minutes since the **PRIOR DATA** determination was made is displayed steadily in the **CYCLE MINUTES** display and the green LED above the **PRIOR DATA** switch is lighted. Each time the switch is pressed the monitor will display the next previous determination data along with the age of this data in the **CYCLE MINUTES** display. A total of 100 previous determinations may be recalled as long as the oldest determination is no older than 99 minutes. Any determination older than 99 minutes is discarded. Prior data will be stored in memory as long as the front panel **ON/OFF** switch is not turned **OFF**. When the **OFF** switch is pressed, all memory is erased.
13	**BATTERY**	This amber LED indicator lights when the **ON** switch is pressed to indicate that the battery is powering the monitor electronics. A flashing **BATTERY** indicator means that battery voltage has fallen below 11.2 Vdc. When the battery voltage falls to 10.5 Vdc, the front panel indicators are extinguished and the monitor ceases to function. If the **BATTERY** indicator does not light when **ON** is pressed and AC power is not applied, it is an indication that the battery is depleted or the internal battery fuse is blown.

TABLE 2-2. MODEL 8100T FRONT PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
14	**ON**	This white membrane switch controls the DC power to the monitor electronics. Pressing **ON** applies power to the monitor and, if AC power is not applied, lights the **BATTERY** LED indicator.
15	**OFF**	This white membrane switch turns off DC power to the monitor electronics. It does not control the AC power applied to the battery charger circuits.
16	**MAINS AC**	This green LED indicator lights when the line cord is plugged into an appropriate AC outlet. If the **MAINS AC** indicator does not light when AC power is applied, it is an indication that the line fuse(s) has blown. Some international units have an AC power switch on the rear of the monitor. For the **MAINS AC** indicator to light the power switch must be in the "I" position.
17	**ACTIVE PROBE CONN.**	Electronic connector for the probe that is used to take a temperature determination.
18	**CUFF (input)**	Threaded pneumatic connector for the cuff hose return connection. This connector ports the cuff pressure to the pressure transducer inside the unit. Either cuff hose may be attached to this connector.
19	**CUFF (output)**	Threaded pneumatic connector for the cuff hose output connection. This connector ports the air pump to the cuff and also connects internally to the DEFLATE VALVE and the OVERPRESSURE switch. Either cuff hose may be attached to this connector.
20	**LOW LIMIT**	This gray membrane switch scrolls through the allowable low limit settings for the vital sign parameter selected (see item 22, **SELECT**).

TABLE 2-2. MODEL 8100T FRONT PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
21	**SILENCE**	This gray membrane switch disables and enables the audio alarm for all patient alarms and some system alarms. At power up the audio alarm is enabled. Pressing this switch will disable the audio alarm and light the amber LED indicator. When an alarm occurs the LED will flash. However, should a hardware or software system alarm, 800 or 899 occur while the audio alarm is disabled, the silenced state will be overridden and the audio alarm will sound with the flashing LED. Pressing the switch when the audio alarm is disabled will enable the audio alarm.
22	**SELECT**	This gray membrane switch selects the vital sign parameter to be viewed and enables the **HIGH LIMIT** and **LOW LIMIT** switches to display and change the limits. Each time the switch is pressed the monitor blanks all displays except the parameter selected. Each press of the switch steps through the vital sign parameters in the following order: 1st press - **SYSTOLIC** 2nd press - **TEMPERATURE** 3rd press - **PULSE** 4th press - **DIASTOLIC** 5th press - returns to original display.
23	**HIGH LIMIT**	This gray membrane switch scrolls through the allowable high limit settings for the vital sign parameter selected (see item 22, **SELECT**).
24	**NORMAL/ MONITOR**	This gray membrane switch selects the mode of temperature measurement as indicated by the adjacent, green LED's. **NORMAL** mode is entered when power is first applied (switched **ON**) and causes the monitor to enter the predictive algorithm whenever the **START (reset)** (item 25) switch is pressed. The unit displays an estimated temperature within 30 seconds from the time the **START** switch is pressed.

TABLE 2-2. MODEL 8100T FRONT PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
24	**NORMAL/ MONITOR** Cont.	When the mode is switched to **MONITOR** the temperature of the probe (in the range of 85.0 °F to 108.0°F or 29.4°C to 42.2°C) is constantly displayed and updated every 1.5 seconds.
25	**START (reset)**	This green membrane switch starts the temperature determination when the monitor temperature mode is **NORMAL**. The start of the determination is indicated by an audible beep and the **TEMPERATURE** display flashes progressive dashes until the temperature reading is displayed (usually within 30 seconds). When the temperature mode is **MONITOR**, any temperature limit alarms will be cancelled and disabled for a period of two minutes.
26	**°F/°C**	This gray membrane switch selects the temperature value to be displayed in degrees Fahrenheit or Centigrade as indicated by the associated green LED's.
27	**PROBE COVER STORAGE**	This is the area used to store a box of probe covers.
28	**PULSE bpm**	This seven-segment, three-digit, yellow LED display shows the pulse rate bpm found during the previous blood pressure determination. When viewing the **PULSE** alarm limits (see item 22, **SELECT**), it shows the selected high or low alarm limits.This display is also used to flash 800 and 900 series alarm codes.
29	**TEM-PERATURE**	This seven-segment, four-digit, yellow LED display shows temperature in Fahrenheit (°F) or Centigrade (°C) as selected by the **°F/°C** switch (item 26). When viewing the **TEMPERATURE** alarm limits (see item 22, **SELECT**), it shows the selected high or low alarm limits.
30	**ACTIVE PROBE STORAGE**	This is the storage area for the probe that is used to take a temperature determination.

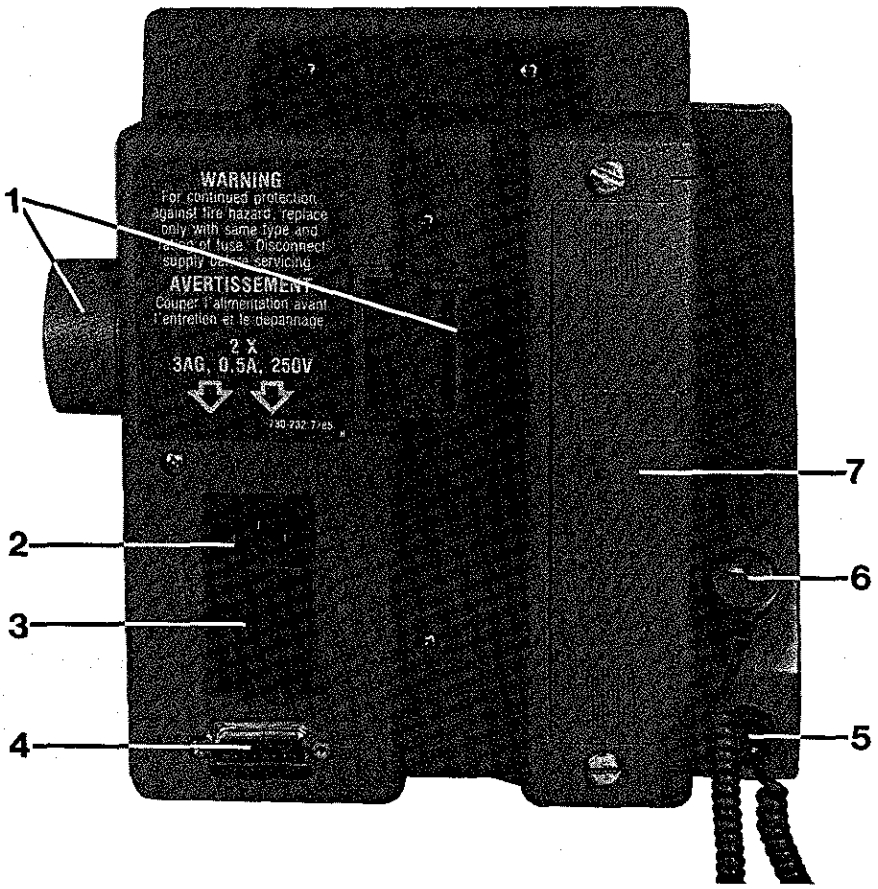


Figure 2-2. Model 8100T Rear Panel Controls, Indicators and Connections

TABLE 2-3. MODEL 8100T REAR PANEL CONTROLS, INDICATORS and CONNECTIONS

ITEM	NAME	FUNCTION
1	POLE CLAMP	Clamps monitor securely to pole.
2	LINE POWER CONNECTOR	AC power cord connector.
3	AC LINE FUSES	Contained under latched fuse compartment door. See 2.4.3 Electrical Specifications for ratings.

TABLE 2-3. MODEL 8100T REAR PANEL CONTROLS, INDICATORS and CONNECTIONS Cont.

ITEM	NAME	FUNCTION
4	**DATA INTERFACE CONN.**	Port for connection of external computer. **Note**: The maximum non destructive voltage which may be applied to any pin on the Data Interface Port is +5v.
5	**INACTIVE PROBE CONN.**	Input connector storage for the extra probe that ***is not*** being used to take a temperature determination.
6	**INACTIVE PROBE STORAGE**	This is the storage area for the extra probe that ***is not*** being used to take a temperature determination.
7	**BATTERY COMPART-MENT**	Contains internal battery. Removal of two screws allows changing battery without affecting other internal parts.

Note

Some international units have an AC power switch. This switch is located in the area between items 3 & 4 (shown in Figure 2-2) and controls the AC power to the monitor.

"**I**" = ON

"**0**" = OFF

2.3 FUNCTIONAL DESCRIPTION

The Model 8100T DINAMAP™ Vital Signs Monitor is a battery-powered or AC line-powered, microprocessor controlled, portable vital signs monitor which automatically determines a patient's blood pressure, pulse rate and temperature.

The Monitor provides accurate determinations of blood pressure and pulse rate for all patients, ranging from neonatal to adult, using the oscillometric technique.

Two modes are provided for temperature evaluation; NORMAL mode allows fast (within 30 seconds of pressing **START**) temperature predictions, and MONITOR mode provides a continuous display of the temperature at the probe site.

All vital signs are shown in large, easy to read digital displays on the front of the unit along with a flashing indicator of the age (in minutes) of the vital signs displayed. Provisions are made for storing and retrieving all vital sign determinations along with their age in minutes and any alarm conditions that existed at the time the determination was displayed.

2.3.1 Blood Pressure Determination Sequence

A blood pressure determination sequence begins when the **START** switch is pressed in **MANUAL** or **AUTO** mode, or when cycle time has expired in **AUTO** mode, or when the mode is switched from **MANUAL** to **AUTO**. The determination sequence begins with a pump up to approximately 50 mmHg at which time a short deflation is performed to establish the size of the cuff/hose combination attached to the monitor. Based on this, the initial target pressure, transducer sensitivity, pressure steps and alarm limits are automatically adjusted. The monitor then pumps up to the initial target pressure (approximately 178 mmHg for adult/pediatrics, 125 mmHg for neonates).

After the initial pump-up pressure is reached, the monitor begins a stepped deflation sequence (refer to Figure 2-3) to determine blood pressure and pulse rate. The monitor uses a sensitive pneumatic pressure transducer in the cuff inflation system which not only measures cuff pressure but also senses minute pressure fluctuations (oscillations) induced in the cuff. Oscillations in the cuff pressure produced by the patient's pulse are detectable by the monitor even when the arterial blood flow is occluded. The pressure oscillations (pulsations) are depicted on each step of the deflation sequence shown in Figure 2-3. The monitor deflates the cuff one step each time it detects two pulsations of relatively equal amplitude. The time duration of each step is dependent on the frequency of the matched pulses (pulse rate of the patient). If the monitor is unable to find any matched pulses within 1.6 seconds it will deflate the cuff another step. This process of finding matched pulses at each step provides rejection of artifacts produced by patient movement and enhances the accuracy of the monitor.

2.3.1 Blood Pressure Determination Sequence Continued

At each step, the monitor stores the cuff pressure, the matched pulse amplitude, and the time between successive pulses. The stepped deflation continues until the monitor determines diastolic pressure or until the cuff pressure falls below 7 mmHg, at which time the monitor deflates the cuff to zero, analyzes the stored data and updates the front panel displays.

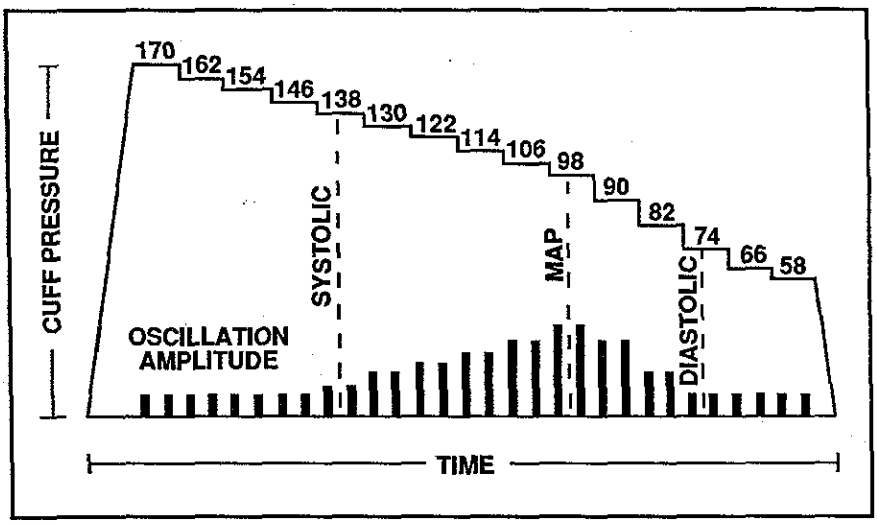


Figure 2-3. Blood Pressure Determination Sequence

2.3.1.1 SYSTOLIC SEARCH. At pressures above systolic, the artery is occluded and there is no arterial flow. The pulsations induced in the cuff are detected to be very low and relatively constant in amplitude. As the cuff pressure is stepped down , a sudden increase in the amplitude of the matched pulses establishes the systolic pressure. If during the first determination the monitor finds that the initial pump-up pressure did not occlude the artery it will stop the stepped deflation and pump up to a pressure 70 mmHg above the initial target pressure and begin the stepped deflation again. After the first determination, the initial pump-up pressure is adjusted to be 25 mmHg for adults (20 mmHg for neonates) above the previous systolic or 73 mmHg for adults (50 mmHg for neonates) above the previous MAP if systolic was not found. If the patient's systolic rises between determinations to the point that the new pump-up pressure does not occlude the artery, the monitor will detect this after the first few deflation steps, stop deflation, pump up an additional 50 mmHg, and begin the stepped deflation again. The maximum systolic pressure detected is 245 mmHg for adult/pediatrics or 190 mmHg for neonates. The minimum systolic pressure detected is 30 mmHg for all patients.

2.3.1
Blood Pressure Determination Sequence
Continued

2.3.1.2 DIASTOLIC PRESSURE. As the monitor continues to step down the cuff pressure, it detects the lowest cuff pressure at which the matched pulses reach their highest amplitude. This pressure is the mean arterial pressure (MAP) and is used by the software to verify the sensed systolic and diastolic pressures. As cuff pressure is further stepped down, the amplitude of the matched pulses falls until it reaches a low, relatively constant level. The pressure at which this first occurs is determined to be diastolic. The maximum diastolic pressure is 210 mmHg for adult/pediatrics or 160 mmHg for neonates. The minimum diastolic pressure detected is 10 mmHg for all patients.

2.3.1.3 PULSE RATE. After blood pressure is found, the monitor computes the median rate of all the matched pulses compiled during the determination and displays this as pulse rate. The maximum pulse rate detected is 200 bpm for adult/pediatrics or 220 bpm for neonates. The minimum pulse rate detected is 40 bpm for all patients.

2.3.1.4 Undetermined Systolic and Diastolic Pressures
Under certain circumstances, the monitor may zero out the systolic and diastolic displays. If the patient is in shock, the systolic/diastolic waveform has very low amplitude fluctuations as shown below:

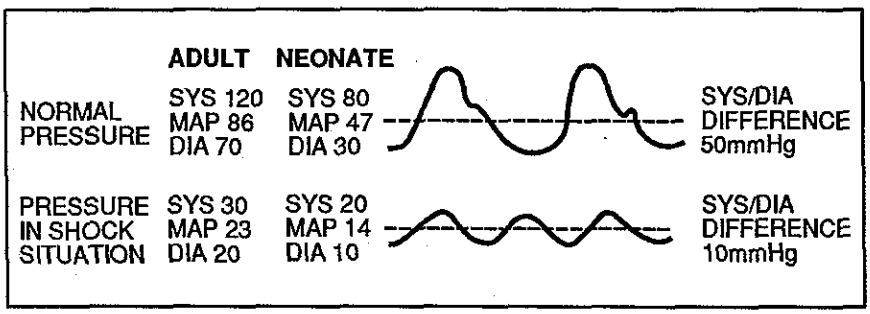


Figure 2-4. Low Amplitude Waveform

Because of the relatively small difference between systolic and diastolic pressure in a shock situation , only MAP can be accurately determined. If this should occur while the monitor is in AUTO mode, the monitor will attempt one more determination after a 15 second wait.

2.3.2 Temperature Determinations

Temperature determinations may be made in Centigrade or Fahrenheit as selected by the front panel switch and indicated by the appropriate LED's. Two modes are provided for these measurements: Normal Mode (predictive), and Monitor Mode (continuous measurement of the probe temperature).

2.3.2.1 Normal (predictive) Mode. In NORMAL mode, a predictive temperature is calculated and displayed approximately within 30 seconds after pressing the START (reset) switch. This prediction will be displayed for 60 seconds and then the display will be blanked again.

2.3.2.2 Monitor (continuous) Mode. In MONITOR mode, the Monitor will continuously display the temperature of the attached temperature probe. The display is updated every 1.5 seconds. The unit will blank for temperatures less than 85° F (29.4° C).

2.3.3 Alarm Provisions

Visual and audible alarms are provided to alert the operator when:

- any patient vital sign has exceeded preset limits,
- the monitor is unable to control certain pneumatic conditions or when the monitor doesn't detect a pulse or temperature (800, E00 Series Alarm Codes),
- and when any internal hardware or software error has occurred (900 Series Alarm Codes).

2.3.3.1 VITAL SIGNS LIMIT ALARMS. Each vital sign monitored (**SYSTOLIC, DIASTOLIC, TEMPERATURE, PULSE RATE**) has preset high and low limit alarms which are assigned at power-on. These alarm limits may be changed at any time using the front panel **ALARM** section switches. The preset (default) blood pressure alarm limits are assigned according to the type cuff and hose used at inflation time.

When any vital sign alarm limit is exceeded, the monitor will flash the digital display of the parameter in alarm, flash the **ALARM** LED, and sound four short beeps every four seconds. Initially, the audible alarm is sounded at its lower volume and if it is not silenced or cancelled within 15 seconds it increases in volume. At the end of another 15 seconds it is sounded at full volume until it is silenced, cancelled or until another determination finds the vital sign within the alarm limits.

2.3.3
Alarm Provisions

2.3.3.2 BLOOD PRESSURE SYSTEM ALARMS (800 SERIES). Blood pressure system alarms may be caused by things such as kinked or blocked hoses, disconnected cuff or hose, leaks in the cuff/hose/pneumatic system, excess pump-up pressure, excessive artifact, a very weak pulse or no pulse at all. When one of these occurs, the vital signs displays are blanked and the appropriate 800 series alarm code is flashed in the **PULSE** display, the **ALARM** LED is flashed, and four short beeps are sounded every four seconds. The possible cause of each 800 series alarm is defined and the appropriate action is given on the side of the monitor. Initially, the audible alarm is sounded at its lower volume and if it is not silenced or cancelled within 15 seconds, it increases in volume. At the end of another 15 seconds it is sounded at full volume until it is silenced, cancelled or until another determination is performed successfully.

2.3.3.3 TEMPERATURE SYSTEM ALERT CODES (E00 SERIES). Temperature system alert codes may be caused by excessive movement of the probe, loss of tissue contact and probe assembly is not connected or, is inoperable. When one of these occurs there is a double beep and the appropriate code is flashed in the **TEMPERATURE** display. The possible cause of each E00 series alarm is defined on the side of the monitor.

2.3.3.4 INTERNAL ERROR ALARMS (900 SERIES). Internal error alarms may be caused by internal hardware or software failures. Depending on the severity of the failure, the vital signs displays may or may not be blanked and the 900 series alarm code may or may not be flashed in the **PULSE** display. In all cases, however, the audible alarm will be sounded at a constant high level, continuous tone. The alarms can only be cleared by turning power OFF and then ON again, and even this may not clear the alarm. In any case, the 900 series hardware alarms are defined in Section 5 of this manual. Alarms not defined in Section 5 should be recorded and the monitor referred to Critikon Field Service for repair.

2.3.4 Blood Pressure Operating Modes

The Model 8100T has three modes of operation: Manual, Auto, and Calibration. The Manual mode allows a single blood pressure determination to be initiated from the front panel of the monitor each time the START switch is pressed. Auto mode performs blood pressure determinations as often as every minute or as infrequently as once every 90 minutes based on a cycle time set by the operator. Calibration mode allows service personnel to check the operation of the front panel indicators and to use the digital displays to present certain diagnostic information. The monitor may also be completely controlled by an external computer attached to the serial data port on the rear. The remote computer may monitor all determinations and states of operation or it can lockout the front panel switches and completely control the monitor's operation.

2.3.5 Prior Data Log

Static RAM memory has been provided in the Model 8100T to provide storage of the results of each determination up to a maximum of 100 determinations for a maximum period of 99 minutes. Each determination display may be recalled and displayed on the front panel by successively pressing the **PRIOR DATA** switch. Each time the switch is pressed the **PRIOR DATA** LED is lighted and the next oldest determination is displayed along with the number of minutes since the determination was made. As a determination becomes older than 99 minutes it is removed from the Prior Data Log.

2.4 SPECIFICATIONS

The Model 8100T Vital Signs Monitor has been designed and manufactured to meet the requirements of the following specifications:

CSA Standard C22.2, No. 125-1984, Electromedical Equipment (Domestic Units)

UL Standard No. 544, Medical and Dental Equipment (Domestic Units)

Regulations for Sale and Testing of Electrical Equipment, City of Los Angeles Department of Building and Safety (Domestic Units)

IEC Standard Publication 601-1, Safety of Medical Electrical Equipment (International Units)

Specification for Safety of Medical Equipment BS5724, Part I, 1979, British Standards Institution (British Units)

2.4.1 Mechanical Specifications

The mechanical specifications for the Model 8100T are as follows:

SPECIFICATION	COMPLIANCE
SIZE	9.1 inches high; 7.9 inches wide (excluding knob); 6.9 inches deep.
WEIGHT	9.6 pounds, approximately.
COLOR	Monitor - blue case with black front panel; Oral Probe - blue; Rectal Probe - red.
MOUNTINGS	Horizontal Surface; four rubber feet. Pole Mount; Integral pole mount and clamp accepts 3/8 inch to 1-1/4 inch diameter pole.
PORTABILITY	The monitor can be hand carried by the Tablet Holder or recessed handle. When attached to the 3207/3208 Stand, the monitor and accessories can be wheeled from patient to patient.
PLACARDS	Operating instructions and precautions affixed to left side. Alarm codes defined on right side.
BATTERY ACCESSIBILITY	Battery compartment door located on left rear of unit allows easy replacement.
POWER CABLE	DOMESTIC - 10 foot, detachable, blue jacketed 16 gauge terminated with a three-prong hospital grade plug. INTERNATIONAL - 10 foot, detachable, blue jacketed, 16 gauge unterminated.

2.4.2 Environmental Specifications

The environmental specifications for the Model 8100T are as follows:

SPECIFICATION	COMPLIANCE
OPERATING TEMPERATURE	+10° C to +40° C (+50° F to +104° F)
STORAGE TEMPERATURE	-34° C to +75° C (-29° F to +167° F)
HUMIDITY RANGE	0% to 95%, non-condensing.
ALTITUDE	-1000 to +15,000 feet.

2.4.2 Environmental Specifications Continued

BF SYMBOL: This symbol indicates the classification of this type of equipment is in compliance with IEC Publication 601-1 and BS 5724-1, Type BF.

ATTENTION: Consult accompanying documents.

2.4.3 Electrical Specifications

The electrical specifications for the Model 8100T are as follows:

SPECIFICATION	COMPLIANCE	
INPUT VOLTAGE	DOMESTIC -	120 Vac/60 Hz (nominal), 104-132 Vac, 47-63 Hz
	INTERNAT'L -	100 Vac/50 Hz (nominal), 88-112 Vac, 47-63 Hz
	INTERNAT'L -	230 Vac/50 Hz (nominal), 194-268 Vac, 47-63 Hz
INPUT POWER	0.4 Amps maximum @ 100, 120 Vac 0.2 Amps maximum @ 220, 230, 240 Vac	
AC FUSE REQUIREMENTS	100 Vac/50 Hz - 2 each, 0.5 Amp, 3AG, 250 V. 120 Vac/60 Hz - 2 each, 0.5 Amp, 3AG, 250 V. 220 Vac/50 Hz - 2 each, 0.25 Amp, FST, 250 V. 240 Vac/50 Hz - 2 each, 0.25 Amp, FST, 250 V.	
DC FUSE REQUIREMENTS	Battery Fuse - 1 each, 2.0 Amp, FST, 250 V.	
BATTERY	12 volt, 2.4 Amp-hour, sealed lead acid.	

2.4.4 Performance Specifications

The performance specifications for the Model 8100T are as follows:

SPECIFICATION	COMPLIANCE	
CUFF PRESSURE RANGE	Adult/Pediatric	0 mmHg to 250 mmHg
	Neonatal	0 mmHg to 235 mmHg
INITIAL CUFF INFLATION	Adult/Pediatric	178 ± 15 mmHg
	Neonatal	125 ± 15 mmHg

2.4.4 Performance Specifications Continued

SPECIFICATION	COMPLIANCE	
BLOOD PRESSURE DETERMINATION RANGES	SYSTOLIC	30 to 245 mmHg (Adult/Pediatric) 30 to 190 mmHg (Neonates)
	DIASTOLIC	10 to 210 mmHg (Adult/Pediatric) 10 to 160 mmHg (Neonates)
	PULSE	40 to 200 bpm (Adult/Pediatric) 40 to 220 bpm (Neonates)
BLOOD PRESSURE ACCURACY	Blood pressure accuracy meets or exceeds proposed AAMI standards for non-invasive blood pressure accuracy. (AAMI Standard: ± 5 mmHg mean error, < 8 mmHg standard deviation as compared to central aortic pressure.)	
STATIC PRESSURE ACCURACY	Displayed pressures will not vary by more than the greater of ± 3 mmHg or ± 2% from that of a mercury manometer in the range of 0 mmHg to 250 mmHg.	
BLOOD PRESSURE DETERMINATION TIME	20 seconds to 45 seconds typical; 120 seconds maximum.	
OVERPRESSURE CUTOFF	310 mmHg, ± 45 mmHg - Adult/Pediatric 235 mmHg, ± 10 mmHg - Neonates	
PULSE RATE ACCURACY	± 3.5 percent.	
DISPLAYED TEMPERATURE RANGE	Normal Mode (Max.) 108.0° F (42.2° C) (Min.) 88.0° F (31.1° C) Monitor Mode (Max.) 108.0° F (42.2° C) (Min.) 85.0° F (29.4° C)	
MONITOR MODE TEMPERATURE ACCURACY	Meets ASTM E1112-86: ± 0.1° C in the range of + 37.0° C to + 39.0° C. ± 0.2° F in the range of + 98.0° F to + 102.0° F.	
NORMAL MODE TEMPERATURE DETERMINATION TIME	Displayed after **TEMPERATURE START** switch is pressed: 30 seconds typical; 60 seconds maximum.	
MONITOR MODE TEMPERATURE DETERMINATION TIME	The thermistor temperature of the attached temperature probe is continuously displayed and updated every 1.5 seconds.	

2.4.4 Performance Specifications Continued

SPECIFICATION	COMPLIANCE
BATTERY CHARGING	To at least 90% capacity in 16 hours. Unit will operate and charge battery simultaneously when connected to an AC power source.
BATTERY OPERATING TIME	6 hours minimum operation (5 minute cycle time with adult cuff at 25° C.)

SECTION 3. INSTALLATION AND OPERATION

3.1 INTRODUCTION

This section of the manual presents: mechanical and electrical installation procedures; lists the Indications, Contraindications, Operating Warnings, Precautions and Notes; describes the basic operating cycle and operating sequences; plus gives procedures for initiating operation and setting alarm limits.

3.2 MECHANICAL INSTALLATION

The Model 8100T is designed for surface mounting on a horizontal surface or pole mounting using the integral pole mount clamp. The unit measures 9.1 inches high by 7.9 inches wide (excluding knob) by approximately 6.9 inches deep and weighs approximately 10 pounds. Screw-on cuff connectors at the front of the unit accommodate 8, 12 or 24 foot hoses. Electrical connections are made at the rear with accommodations for a 10 foot AC power cord and a customer supplied communications connector and cable.

3.2.1 Surface Mounting

Four rubber feet are attached to the bottom of the monitor to provide for a firm, skidfree mounting on a horizontal surface. Remember to provide clearance for the front-attached hose, probe and the rear-attached power and communication cords.

3.2.2 Pole Mounting

The integral pole mount allows the Model 8100T to be clamped to a square or round pole or bedstead as small as 3/8 inch or as large as 1-1/4 inch. Clean the pole or bedstead and wipe the urethane pad on the pole clamp with mild detergent. Open the pole clamp by turning the knob counter-clockwise and fit the pole within the recess of the pole clamp. Tighten the pole clamp by turning the knob clockwise as far as you can by hand.

3.2.3 Initial Setup

Shown below are brief instructions for setting up the Model 8100T Unit.

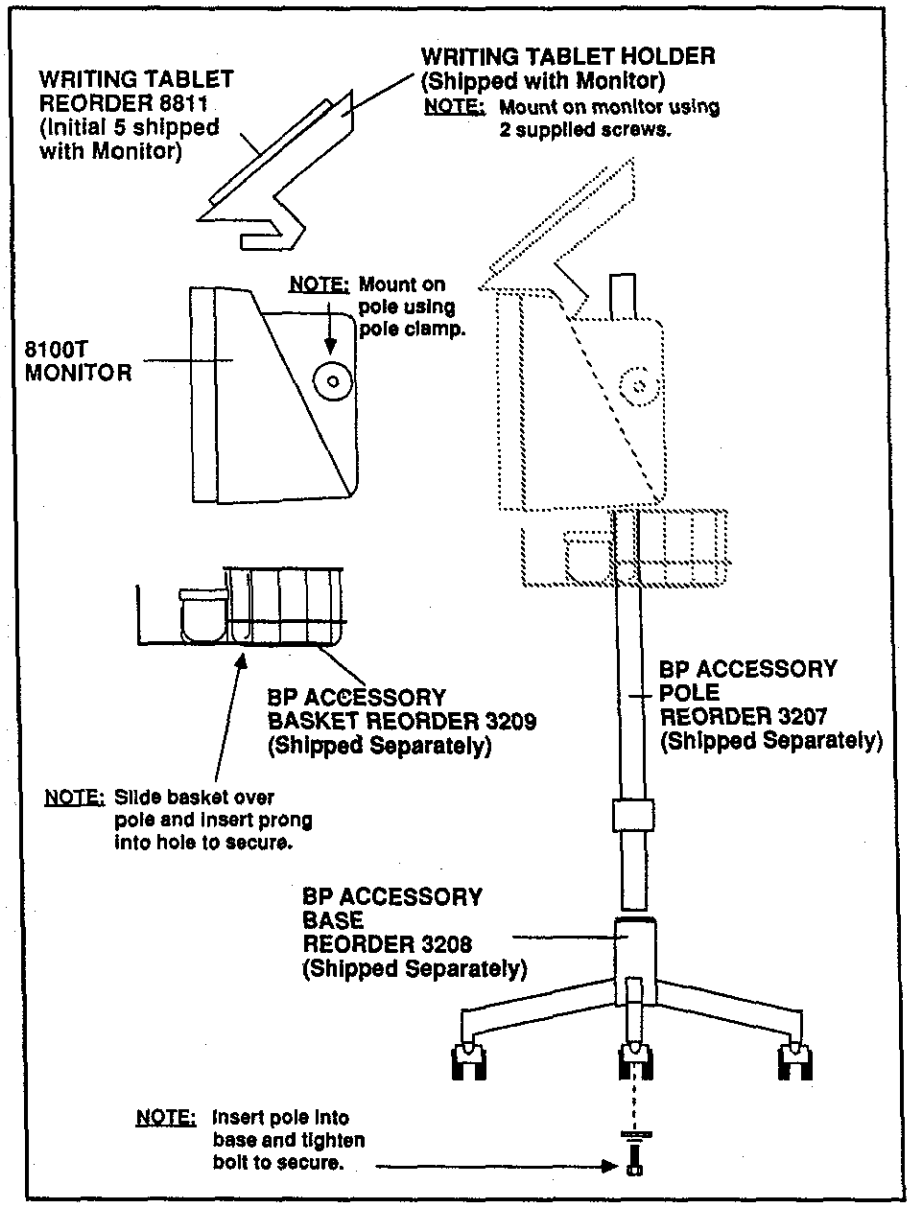


Figure 3-1. Initial Setup - Model 8100T Unit Assembly

3.2.4 Writing Tablet Holder Installation

The writing tablet holder comes with two screws and requires a Phillips screwdriver for installation. To install the writing tablet holder:

1. Facing the rear panel, remove and discard the two screws located inside of the molded carrying handle finger well.

2. Holding the writing tablet holder in place, substitute the longer screws provided (placing them first through the holder), as shown in Figure 3-2.

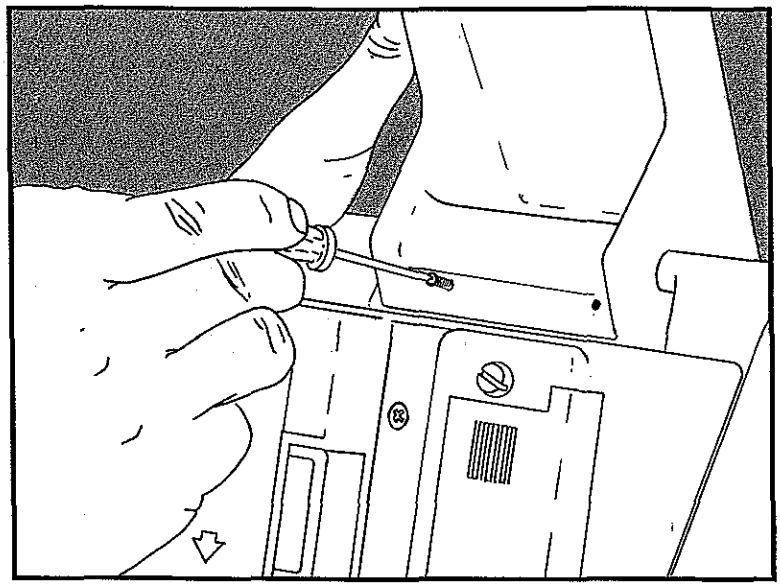


Figure 3-2. Writing Tablet Holder Installation

3. To place a tablet in the holder, fit the two slots in the tablet over the two mounts on the tablet holder surface.

3.2.5 Temperature Probe Holder Connections

The Model 8100T is shipped with two temperature probes. One is color coded blue for oral use and the other is coded red for rectal use. Both can be stored along with a box of probe covers in the probe holder. The holder attaches to the unit's left (facing) side panel (see Figure 3-3). To attach the probe holder:

1. Position the holder with the probe cover box slot facing forward and align the holder's upper and lower inner connection holes with the unit's connection posts as shown in Figure 3-3.

2. When aligned, press the holder and unit firmly together.

3.2.5 Temperature Probe Holder Connections Continued

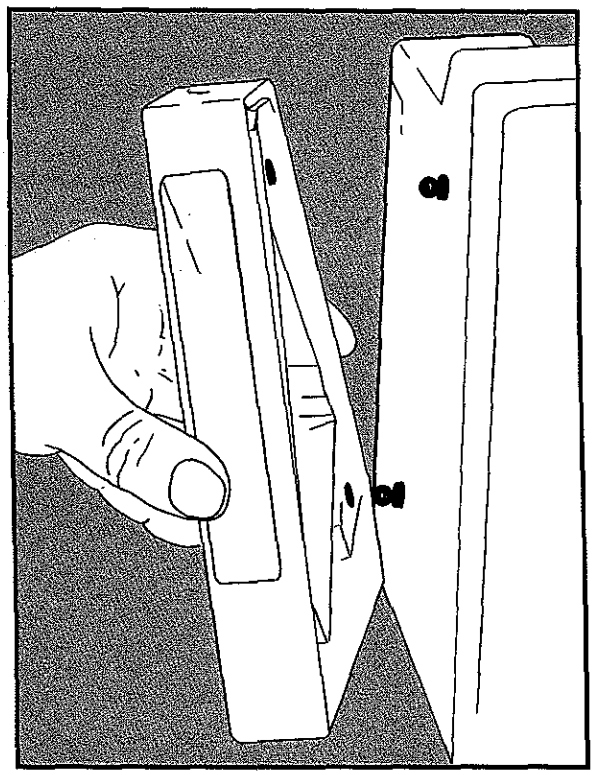


Figure 3-3. Probe Holder Installation

3. Obtain a box of temperature probe covers and tear back box flap. Place the box in the angled probe cover slot (opening toward bottom) so that the covers naturally fall toward the opening as they are used.

4. Connect the cable plug end of one temperature probe into the input connector (labeled PROBE) at the bottom of the unit's front panel, by aligning the pins and pushing the plug in.

PRECAUTION

When using the temperature probe, be very careful not to overextend the coiled cord. Overextension can cause the connector at the monitor front panel to pull loose and snap forward.

5. Place the probe in the probe holder slot on the top of the holder.

   The other probe can be stored in the alternate probe slot located on the rear of the probe holder. A probe connector receptacle is provided to prevent damage to the alternate probe connector and to keep the alternate probe cord out of the way.

3.2.5 Temperature Probe Holder Connections Continued

Note

Probe storage and receptacle connection in back of the unit is not electrically connected and cannot be used to take a temperature determination.

3.3 EXTERNAL CONNECTIONS

External connections are confined to connecting the AC power cord and making connections to the external computer or strip chart recorder.

It is advisable to connect the AC power cord to the monitor and plug it into an appropriate AC outlet when first unpacked. On the international units that have an AC power switch on the back, place the switch in the "I" position. Charge the battery for at least 16 hours before using the monitor on strictly battery power.

If you desire to connect a strip chart recorder to the analog signals for cuff pressure and pulse complexes, you will have to make a mating connector and cable for connecting to the 15-pin interface connector on the rear of the unit.

If you desire to connect the monitor to an external computer for purposes of controlling the monitor and reading determination data in serial character format, you will have to make a mating connector and cable for connecting the 15-pin interface connector on the rear of the unit.

3.3.1 AC Power Cord Connection

Plug the AC power cord into the monitor. Plug the other end into a hospital grade AC outlet rated at the same voltage and frequency as printed on the monitor Serial Number label. If the **MAINS AC** indicator does not light when AC power is applied, check the AC line fuses as described in SECTION 5. MAINTENANCE.

Note

Some international units have an AC power switch on the rear of the monitor. For the **MAINS AC** indicator to light the power switch must be in the "I" position.

3.3.2 Strip Chart Recorder Connections

Make up a connecting cable using a DA15P connector to mate with the data interface connector on the rear of the monitor using the pin assignments as shown. Keep in mind that the source impedance for each analog output is 10,000 ohms and the output voltage can swing from 0 to +4.5 volts.

DA15P PIN	SIGNAL ASSIGNMENT
7	Analog Signal Ground
8	Cuff Pressure Signal
9	Pulse Complex Signal

3.3.3 Remote Computer Connections

The monitor transmits and receives ASCII characters asynchronously at a 600 Baud rate: 1 start bit, 8 data bits, 1 stop bit, no parity. The signal connections are effected at the DA15S connector on the rear of the 8100T using 0 and +5 Vdc logic level signals (MARK = 0V, SPACE = +5V) which may be transmitted and received up to a distance of about 6 feet. RS232 signal levels can be provided by connecting a Critikon Model 8801 RS232 Adaptor to the rear connector. Make up a connecting cable using a DA15P connector to mate with the data interface connector on the rear of the monitor (or a DB25P to mate with the RS232 adaptor) using the pin assignments as shown.

DA15P PIN	DB25P PIN	SIGNAL ASSIGNMENT
2	2	Transmit Data (TxD) Signal
3	3	Receive Data (RxD) Signal
7	7	Communication Signal Ground

Refer to the OPERATION section for serial data formats on all transmitted and received commands and data.

3.4 OPERATION

3.4.1 Pre-Operational Checks

1. Check the voltage and frequency rating stamped on the serial number plate attached to the bottom of the monitor and make sure that it matches the line voltage and frequency of the receptacle to be used.

2. Connect the pneumatic hose to the monitor at the front panel. There is no preferred order of connection; either hose connector may be attached to either port. Thread the hose connectors onto the monitor ports until finger-tight. DO NOT OVERTIGHTEN. The pneumatic seal does not depend on extreme connector tightness.

3.4.1
Pre-Operational Checks
Continued

3. Select the appropriate measurement site (see Figure 3-4). For neonates, the arm or leg can be used. For adult/pediatrics, the preferred location is the upper arm. When the arm cannot be used, placement on the ankle or forearm is preferred over the thigh since measurement on the adult thigh can be uncomfortable. When there is no suitable alternative for the thigh (e.g. shock), set the monitor's blood pressure determination cycle to five (5) minutes or longer, unless the clinical situation requires more frequent measurement.

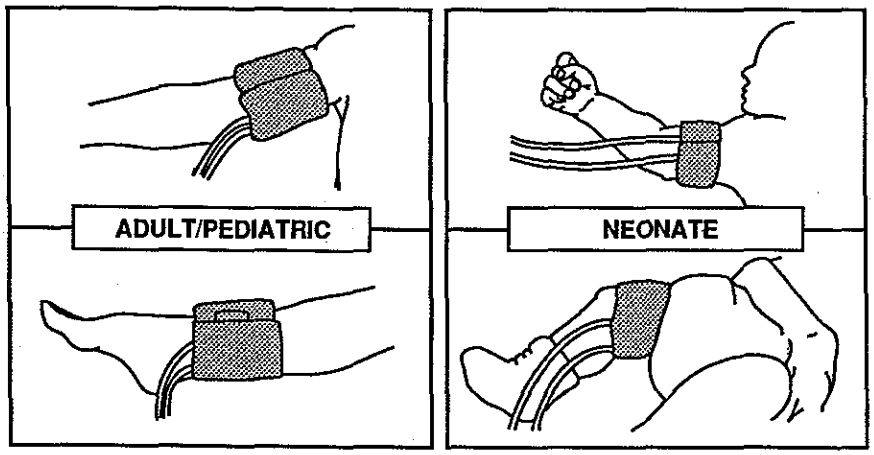


Figure 3-4. Recommended Cuff Placement

WARNING

Do ***not*** place the cuff on an extremity being used for intravenous infusion, or any area where circulation is compromised or has the potential to be compromised.

4. Measure the limb of the patient and select the proper size cuff according to the size marked on the cuff or cuff package (See Table 3-1). **The monitor's accuracy depends on the application of the proper size cuff and hose type.**

5. Connect the cuff to the hose. If an adult/pediatric cuff and hose are to be used, thread the cuff connectors onto the hose connectors, DO NOT OVERTIGHTEN. If a neonatal cuff and hose are to be used, fit the Luer connections of the cuff into the Luer connector block on the hose.

3.4.1
Pre-Operational Checks
Continued

WARNING

It is mandatory that the 8-foot hose (Light Blue, Reorder No. 8840) be used with neonatal cuffs and the 12 or 24 ft. hoses (Blue, Reorder No's 8841/8842) be used with infant through thigh cuffs. Any attempt to modify hoses will inhibit the monitor from switching to the proper mode.

6. Squeeze all the air from the cuff.

TABLE 3-1. CUFF-TO-HOSE COMPATIBILITY

CUFF TYPE	CUFF SIZE/LIMB CIRCUMFERENCE	CUFF REORDER NO.	HOSE LENGTH	HOSE REORDER NO.
Neonate #1	3.1 cm - 5.7 cm	8311/2638	8 feet	8840
Neonate #2	4.3 cm - 8.0 cm	8312/2633	8 feet	8840
Neonate #3	5.8 cm - 10.9 cm	8313/2628	8 feet	8840
Neonate #4	7.1 cm - 13.1 cm	8314/2623	8 feet	8840
Neonate #5	8.3 cm - 15.0 cm	2619	8 feet	8840
Infant	8.3 cm - 15.0 cm	2783/2618	12 or 24 ft.	8841/8842
Child	12.0 cm - 19.0 cm	2781/2613	12 or 24 ft.	8841/8842
Small Adult	17.0 cm - 25.0 cm	2779/2608/2607	12 or 24 ft.	8841/8842
Adult	23.0 cm - 33.0 cm	2774/2603/2602	12 or 24 ft.	8841/8842
Large Adult	31.0 cm - 40.0 cm	2791/2643/2642	12 or 24 ft.	8841/8842
Thigh	38.0 cm - 50.0 cm	2796	12 or 24 ft.	8841/8842

7. Place the cuff snugly on the patient as shown in Figure 3-4. In the case of upper arm placement, it is recommended to place the cuff as proximaly as possible. Observe the mark on the inside of the cuff to be placed over the artery. Be sure the cuff is snug, but not so tight as to prevent venous return between determinations.

WARNING

Excessive tightness will cause venous congestion and discoloration of the limb, but too loose a cuff may result in no readings and/or inaccurate readings.

8. If it becomes necessary to change the cuff to another limb, make sure the appropriate size cuff is used.

9. Before powering **ON** the monitor, read/review all OPERATING WARNINGS, PRECAUTIONS, and NOTES.

3.4.2 Indications and Contraindications

The DINAMAP™ Portable Monitor Model 8100T is intended for monitoring of blood pressure, pulse rate and temperature. The device is not designed, sold, or intended for use except as indicated.

The monitor should not be used on patients who are linked to heart/lung machines.

3.4.3 Operating Warnings, Precautions and Notes

WARNINGS:

- **In some cases, rapid, prolonged cycling of a noninvasive blood pressure monitor has been associated with ischemia, purpura and/or neuropathy. It is recommended to apply the cuff appropriately and to check the cuff site and cuffed extremity regularly when monitoring at frequent intervals and/or over extended periods of time.**
- **Vital signs may very likely be inaccurate if you use cuffs, hoses, probe covers, or accessories other than those provided by Critikon, Inc.**
- **The monitor will not operate effectively on patients who are experiencing convulsions or tremors.**
- **If a patient is encountering arrhythmias, the monitor's blood pressure determination time may increase and may even extend beyond the monitor's capabilities (120 seconds) causing an 844 system alarm.**
- **The monitor displays results of the last blood pressure determination for 90 minutes or until another determination is completed. If a patient's condition changes during the time interval between determinations, the monitor will not detect the change or indicate an alarm condition.**

PRECAUTIONS:

- **Read and have a thorough understanding of the material presented in the manual.**
- **Read and observe all the caution and warning labels affixed to the monitor.**
- **Place the monitor on a rigid, secure surface or attach securely with the pole clamp.**
- **If the integrity of the electrical ground is in doubt, disconnect the power cord from the power source, and operate the monitor using internal battery.**

3.4.3
Operating Warnings, Precautions and Notes
Continued

- ❒ Arrange the power cord and pneumatic hoses carefully so they do not constitute a hazard.
- ❒ Verify calibrations and ensure that all display digits are functioning properly before operating the monitor.
- ❒ Do not place fluids on the monitor.
- ❒ Do not use the monitor in the presence of flammable anesthetics.
- ❒ If the accuracy of any determination reading is questionable, first check the patient's vital signs by alternate means and then check the monitor for proper functioning.
- ❒ If monitoring blood pressure at frequent intervals, observe the patient's cuffed extremity for signs of impeded blood flow.
- ❒ To obtain accurate blood pressure determinations, extremity and cuff motion must be minimized.
- ❒ Monitor blood pressure accuracy is dependent on the application of the proper size cuff and hose. It is essential that limb circumference be measured and the proper size cuff be selected. See Table 3-1.
- ❒ If the cuff is not at heart level, the difference in the reading due to the hydrostatic effect should be noted. The value of 1.80 mmHg must be added to the displayed readings for every inch above heart level. The value of 1.80 mmHg must be subtracted from the displayed readings for every inch below heart level.
- ❒ The pulse rate displayed by the DINAMAP™ Portable Monitor Model 8100T may differ from the heart rate displayed by an ECG monitor because the DINAMAP™ Portable Monitor Model 8100T measures actual peripheral pulses, not electrical signals from the heart. Occasionally, electrical signals at the heart do not produce a peripheral pulse. Similarly, if a patient's beat-to-beat pulse amplitude varies significantly (e.g. *pulsus alternans*, atrial fibrillation, rapid-cycling artificial ventilator), blood pressure and pulse rate readings can be erratic and an alternate measuring method should be used for confirmation.

3.4.3 Operating Warnings Precautions and Notes Continued

- **Do not allow the tip of the probe to come into contact with a heat source (i.e. hands or fingers) prior to taking a temperature determination. If this occurs, allow five seconds for the probe tip to cool before proceeding.**

- **Axillary temperatures should only be taken in the Monitor Mode. Axillary temperatures taken in the Normal Mode may not be accurate.**

NOTES:

- A patient's vital signs may vary dramatically during the administration of agents affecting the cardiovascular status such as those used to raise or lower blood pressure or raise or lower heart rate.

- Elapsed time flashed in the **B. P. CYCLE/MINUTES** window pertains only to blood pressure determinations, ***not*** temperature.

3.4.4 Turn-On and Checkout

Press the momentary **POWER ON** switch on the front panel and check that the following actions occur:

- The monitor should begin a pulsed audio test,
- then momentarily display all 8's in the digital displays except temperature display (reads 188.8)
- then momentarily light all LED indicators and
- then display 0 in each vital sign display.
- The **MANUAL** indicator and the **BATTERY** and/or **MAINS AC** indicator should be lighted steadily.

Note

Some international units have an AC power switch on the rear of the monitor. For the **MAINS AC** indicator to light the power switch must be in the "**I**" position.

If any or all of these power-on tests fail, refer to Section 5. Maintenance.

3.4.5 Set Vital Signs Alarm Limits

At power-on, adult default* blood pressure alarm limits are in effect and temperature alarm limits are disabled. If the first blood pressure determination is made with a neonatal cuff and hose combination, then the monitor will switch to neonatal default* alarm limits. If the alarm limits are viewed by pressing the **SELECT** switch before a determination is made, then the viewed limits will be in effect when the first determination is made, regardless of the type of cuff attached. Temperature alarm limits are in effect and can be viewed only in **MONITOR** mode. To change alarm limits refer to Figure 3-5.

*Default alarm limits are limits generally found useful in normal clinical situations. They should not be considered as safe limits for any particular patient.

3.4.6 Blood Pressure Determination - Manual Mode

Start a blood pressure determination by pressing **START**.

The monitor immediately performs an auto-zero (a self calibration by opening the pressure transducer to atmosphere and adjusting the offset of the amplifier circuit to produce an indicated zero output).

The monitor then starts the pneumatic pump, begins to flash the **CUFF** indicator above the **SYSTOLIC** display to indicate that a blood pressure determination is in process, and pumps to a pressure of approximately 50 mmHg. It then very briefly deflates the cuff to determine what type of cuff and hose are attached (the results of this test determine the default alarm limits, the initial pump-up pressure, the sensitivity of the amplifier and the size of the pressure steps during deflation).

The pump-up is then continued until the target pressure, based on the cuff typing, is reached. The monitor then begins a stepped deflation sequence, flashing the target pressure of each next deflation step momentarily in the **SYSTOLIC** display until the blood pressure determination is complete. If, however, the monitor finds that the initial pump-up did not occlude the artery, it will stop the deflation and pump-up to a higher target pressure (see Systolic Search, Section 2.3.1.1) and then begin the stepped deflation again. At the end of the determination, the monitor displays the results in the four vital sign displays and begins to flash (every 4 seconds) the number of minutes in **CYCLE MINUTES** since the displayed vital signs were determined. The results of this determination will remain displayed until the results of the next determination replace it or until 90 minutes have elapsed. After 90 minutes, the vital signs displays are zeroed and the **CYCLE MINUTES** display is blanked.

If one of the vital signs exceeds the set alarm limits, the value is flashed in the display and the audio alarm is beeped four times every four seconds. If the alarm is not silenced (press the **SILENCE** switch) or cancelled (press the **CANCEL** switch), after 15 seconds the alarm volume is increased. Other system alarms (800 and 900 series) may occur during a blood pressure determination and, if so, they will be displayed in the **PULSE** display and no vital signs will be displayed. Some of these may be cancelled and some may not (see Alarm Indications and Interpretation).

When **START** is pressed again, the displays will retain the results of the previous blood pressure determination until the new determination is complete. The monitor will then update the displays with the results of the new determination and store the old determination data in RAM as **PRIOR DATA**.

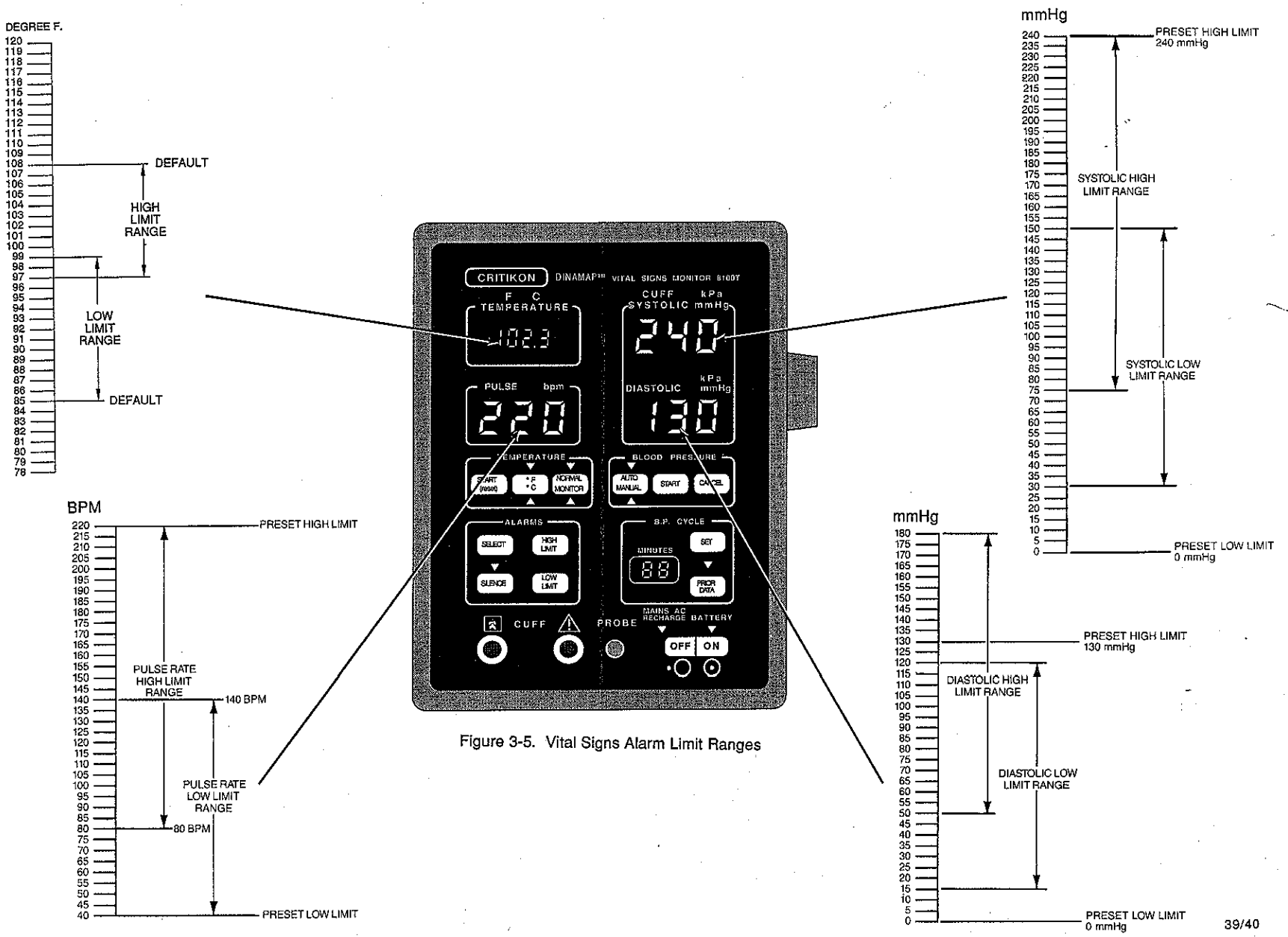


Figure 3-5. Vital Signs Alarm Limit Ranges

3.4.7 Blood Pressure Determination - Auto Mode

Press the **AUTO MANUAL** switch to enter **AUTO** mode. The **AUTO** LED will light, 3 will be displayed in the **CYCLE MINUTES** window, and a blood pressure determination will be immediately initiated. To change the 3 minute cycle time, press the **SET** switch. **CYCLE MINUTES** may be stepped through 1, 2, 3, 4, 5, 10, 15, 20, 30, 45, 60 and 90 minutes by momentarily pressing the switch or they may scrolled through by holding in the switch.

PRECAUTION

The monitor should be set to cycle only as frequently as is necessary to ensure adequate patient monitoring.

Blood pressure determinations in **AUTO** mode are made in the same manner as in **MANUAL** mode with the following exceptions:

1. The age, in minutes, of the displayed vital signs are multiplexed with the cycle time setting in the **CYCLE MINUTES** display. The set cycle time is held steady in the **CYCLE MINUTES** window and the age of the displayed vital signs is briefly flashed every 4 seconds.

2. A new blood pressure determination is automatically initiated at the expiration of the cycle time.

3. The occurrence of a vital sign limit alarm will cause the monitor to initiate an additional blood pressure determination within 15 seconds to verify the alarm condition unless the **CANCEL** switch is pressed.

4. The occurrence of an **899** (insufficient signal, weak pulse or no pulse) system alarm will cause the monitor to automatically attempt up to 9 more consecutive blood pressure determinations to search for a measurable vital sign unless the **CANCEL** switch is pressed.

3.4.8 Temperature Determination - Normal Mode

NORMAL temperature mode is the default (power-up) mode of the monitor. In this mode, the **TEMPERATURE** display is blanked and will remain blanked until the **TEMPERATURE START** switch is pressed. Also, in this mode patient temperature alarms are disabled.

Press the **TEMPERATURE START** switch to begin a normal temperature reading. The **TEMPERATURE** display will indicate that the predictive determination has started by flashing sequential dashes. After approximately 30 seconds (actual time delay depends on the time length the temperature probe has been in place) the predictive temperature will be displayed for 60 seconds and then stored as **PRIOR DATA**. Elapsed time flashed in the **B.P. CYCLE MINUTES** window pertains only to blood pressure determinations, ***not*** temperature.

3.4.9 Temperature. Determination - Monitor Mode

Press the **TEMPERATURE NORMAL/MONITOR** switch to enter **MONITOR** mode as indicated by the **MONITOR** indicator.

MONITOR mode continuously displays (updated every 1 to 2 seconds) the temperature of the probe in the range of 85.0° F to 108° F (the temperature display is blanked below 85° F). The display is stored as **PRIOR DATA** each time a blood pressure determination is made.

In this mode, patient temperature alarms are enabled so you may want to change the limits from the default limits. Default (power-on) temperature alarm limits are: Low Limit = 85.0° F, High Limit = 108° F. Low temperature alarm limits may be adjusted in 0.1° increments between 85.0° F and 97.0° F. High temperature alarm limits may be adjusted in 0.1° increments between 97.0° F and 108.0° F. If the detected temperature exceeds the set limits, the monitor will sound an audible alarm and flash the displayed temperature.

3.4.10 Taking Temperature

3.4.10.1 TAKING ORAL TEMPERATURE.

1. Obtain a blue temperature probe assembly and apply probe cover (P/N 8815). Connect temperature probe to front panel probe connector.

   PRECAUTION

   Accurate oral temperatures can only be obtained by using the blue temperature probe. Blue and red temperature probes are ***not*** interchangeable.

2. Insert the probe under the tongue into the right or left sublingual pocket.

   PRECAUTION

   Accurate temperatures can only be obtained in this location. Temperatures in other mouth locations can vary by more than 2° F or 1° C.

3. Hold the probe steady until determination is complete. Refer to **NORMAL** or **MOITOR** operation modes.

4. After the determination is complete, remove the probe and discard the probe cover by pressing the button on the probe handle.

5. Record the temperature and place the probe into the probe holder.

   Note

   Wait at least five seconds before taking another temperature determination.

3.4.10
Taking Temperature
Continued

3.4.10.2 TAKING RECTAL TEMPERATURE.

1. Obtain a red temperature probe assembly and apply probe cover (P/N 8815). Connect temperature probe to front panel probe connector.

PRECAUTION

Accurate rectal temperatures can only be obtained by using the red temperature probe. Red and blue temperature probes are ***not*** interchangeable.

2. Insert the probe into the patient's rectum (a water soluble lubricant may be used if desired). Insertion depth is recommended at:

Adults	**Children**
1-1/2 inches (4 cm)	3/4 inch (2 cm)

3. To ensure proper tissue contact, hold the probe steady. Refer to **NORMAL** or **MONITOR** operation modes.

4. After the determination is complete, remove the probe and discard the probe cover by pressing the button on the probe handle.

5. Record the temperature and place the probe into the probe holder.

Note

Wait at least five seconds before taking another temperature determination.

3.4.11
Alarm Indications and Interpretation

The alarms generated by the monitor are divided into 4 categories: patient alarms, blood pressure system (800 series) alarms, temperature system (E00 series) alert codes, and internal error (900 series) alarms. If a microprocessor alarm condition is so catastrophic that the microprocessor cannot post a 900 series alarm code, the fail-safe alarm will be generated which sounds a continuous high level audio alarm which is unaffected by the **ALARMS SILENCE** or **BLOOD PRESSURE CANCEL** switches.

3.4.11
Alarm Indications and Interpretation
Continued

3.4.11.1 PATIENT ALARMS. When the results of a determination indicate that one or more of the patient's vital signs have exceeded the set alarm limits, the monitor will flash the display of the parameter(s) which are out of limits, flash the **ALARMS SILENCE** LED, and sound four short beeps every four seconds. At the end of 15 seconds, if the alarm is not silenced, the volume is increased. If the alarm is still not silenced after 15 more seconds, the volume is again increased to its loudest level. If the **ALARMS SILENCE** switch is pressed, the audio alarm will no longer sound but the monitor will continue to flash the **ALARMS SILENCE** indicator and the display of the out-of-limit vital sign. If the **BLOOD PRESSURE CANCEL** switch is pressed, all blood pressure alarm indications will be ceased; this switch has no effect on temperature alarms.

3.4.11.2 BLOOD PRESSURE SYSTEM (800 Series) ALARMS. When, for some reason external to the microprocessor system, the monitor is unable to make a blood pressure determination, it blanks all pressure displays, flashes an 800 series alarm code in the **PULSE** display, and sounds the audio alarm in an ascending fashion just as for the vital signs limit alarms. Some alarms can be silenced by pressing the **ALARMS SILENCE** switch, some cannot. All can be cancelled by pressing the **BLOOD PRESSURE CANCEL** switch. These alarms are as follows:

800 - EXCESS PRESSURE. This alarm is generated when the pneumatic system pressure is sensed by the monitor to be greater than 310 ± 45 mmHg in adult mode or greater than 235 ± 10 mmHg in neonatal mode. It is usually caused by a kinked or pinched hose or cuff tube, or by a quick, violent patient movement or squeezing of the cuff. It can also be caused by an internal pneumatic system blockage, obstruction or a failure of one of the pneumatic valves. This alarm cannot be silenced by pressing **SILENCE** but may be cancelled by pressing **CANCEL**. If external causes are ruled out and the alarm persists, refer to SECTION 5. MAINTENANCE.

833 - CUFF INFLATION TIME OVER 40 SECONDS. This alarm is generated when the pneumatic pump cannot reach the target pressure within 40 seconds. It is usually caused by a leak in the cuff, cuff tubes, cuff connector, hose, or hose connector. It can also be caused by an internal pneumatic system leak or failure of one of the pneumatic valves. This alarm can be silenced by pressing **SILENCE** or cancelled by pressing **CANCEL**. If external causes are ruled out and the alarm persists, refer to SECTION 5. MAINTENANCE.

3.4.11 Alarm Indications and Interpretation Continued

3.4.11.2 BLOOD PRESSURE SYSTEM (800 Series) ALARMS. Continued

844 - DETERMINATION TIME OVER 120 SECONDS. This alarm is generated when the monitor senses that a determination has not been completed and 120 seconds have elapsed since the determination was initiated. It is usually caused by a leak in the cuff, cuff tubes, cuff connector, hose, hose connector, or excessive motion artifact. It can also be caused by an internal pneumatic system leak or failure of one of the pneumatic valves. This alarm can be silenced by pressing **SILENCE** or cancelled by pressing **CANCEL**. If external causes are ruled out and the alarm persists, refer to SECTION 5. MAINTENANCE.

855 - AT ONE PRESSURE LEVEL OVER 60 SECONDS. This alarm is generated when the monitor senses that the pneumatic system pressure has remained at one pressure level, either because no matched pulses were found or despite efforts to step down the pressure. It is usually caused by excessive motion artifacts or arrhythmia, or it may be caused by a kinked or pinched cuff tube or hose. It can also be caused by an internal pneumatic blockage or valve failure. This alarm can be silenced by pressing **SILENCE** or cancelled by pressing **CANCEL**. If external causes are ruled out and the alarm persists, refer to SECTION 5. MAINTENANCE.

888 - NORMAL POWER UP INDICATION OR POWER INTERRUPTION. This is the normal indication when power is first applied to the monitor and lasts only for four or five seconds to test the seven-segment numeric displays. It should only occur when the **POWER ON** switch is pressed when the monitor is **OFF**. If this alarm occurs during any other time, it is an indication that power has been temporarily interrupted and is cause to suspect a hardware malfunction within the unit.

899 - WEAK PULSE OR INSUFFICIENT SIGNAL. This alarm is generated when the monitor is unable to detect a signal strong enough to make a determination. The most appropriate response would be to check the patient since the patient's pulse may be weak or non-existent. Make sure the cuff is wrapped around and secured firmly to the patient's limb. This alarm can be silenced by pressing **SILENCE** or cancelled by pressing **CANCEL**. If external causes are ruled out and the alarm persists, refer to SECTION 5. MAINTENANCE.

3.4.11
Alarm Indications and Interpretation
Continued

3.4.11.3 TEMPERATURE (Normal Mode) SYSTEM (E00 Series) ALERT CODES. When, for some reason external to the microprocessor system, the monitor is unable to make a temperature determination it flashes an E00 series alert codes in the **TEMPERATURE** display. The temperature alert codes are as follows:

E00 - EXCESS DETERMINATION TIME. This alert code is generated if the temperature determination time exceeds 60 seconds.

E11 - LOSS OF TISSUE CONTACT. This alert code is generated when a loss of tissue contact occurs. It is usually caused when the probe is removed before the temperature determination is complete.

E33 - PROBE PROBLEM. This alert code can only occur in NORMAL mode when the probe assembly is not connected or continuity is broken in the probe or probe connector circuits.

3.4.11.4 INTERNAL ERROR (900 Series) ALARMS. Internal diagnostics are continually run by the monitor to detect certain hardware faults before they have a chance to affect accuracy or efficacy. In addition there are software traps programmed into the monitor to detect any software errors. The occurrence of any hardware or software error will cause the monitor to flash a 900 series alarm code in the **PULSE** display and sound a continuous, high-level audio alarm which cannot be silenced or cancelled. The software errors are undefined in this document since they cannot be repaired in the field and should be referred to Critikon Field Service for correction. The hardware error codes are as follows:

901 - TIME BASE COMPARISON ERROR. At least twice a second the microprocessor compares the CPU clock frequency with the clock frequency of the Fail-safe Timer circuit and, if the frequency of either clock is off by more than ± 0.5%, it generates this alarm.

902 - INTERNAL JUMPER ERROR. This error code indicates that one or more jumpers are configured wrong for normal operation and is an indication that certain calibration or test jumpers have been left in the unit after maintenance or test procedures have been performed.

911 - PLUS 5 VDC SUPPLY OUT-OF-LIMITS. This error code indicates that the +5 Vdc supply is out of tolerance.

912 - PLUS 8 VDC SUPPLY OUT-OF-LIMITS. This error code indicates that the +8 Vdc supply is out of tolerance.

913 - MINUS 6 VDC SUPPLY OUT-OF-LIMITS. This error code indicates that the -6 Vdc supply is out of tolerance.

3.4.11 Alarm Indications and Interpretation Continued

3.4.11.4 INTERNAL ERROR (900 Series) ALARMS. Continued

922 - PRESSURE CHANNEL ERROR BEFORE AUTO-ZERO. This error code indicates that the uncorrected transducer output is outside the range of 1 to 50 a-to-d units.

923 - PRESSURE CHANNEL ERROR AFTER AUTO-ZERO. This error code indicates that the auto zero operation failed to establish a zero offset.

924 - MINUS 50 OFFSET PRESSURE CHANNEL ERROR. This error code indicates that the internal offset for high pressure levels is outside the range of 49 to 53 A - to - D units.

925 - OSCILLATION CHANNEL TEST FAILURE. This error code indicates that the unit has failed the oscillation channel (FPT) test.

926 - AUTO-ZERO VERIFICATION ERROR. This error code indicates that the unit has failed the auto-zero verification test at the end of a determination.

927 - TEMPERATURE CALIBRATION ERROR (54°). This error code indicates that the unit has failed the temperature calibration test performed periodically by the software. Specifically, the reading of temperature channel 0 failed to give a reading of 54° F.

928 - TEMPERATURE CALIBRATION ERROR (98°). This error code indicates that the unit has failed the temperature calibration test performed periodically by the software. Specifically, the reading of temperature channel 1 failed to give a reading of 98° F.

929 - TEMPERATURE CALIBRATION ERROR (108°). This error code indicates that the unit has failed the temperature calibration test performed periodically by the software. Specifically, the reading of temperature channel 2 failed to give a reading of 108° F.

930 - TEMPERATURE PROBE TYPE CODE ERROR. This error code indicates that there is a problem with the probe type code (oral/rectal) circuitry in the probe or the probe connector.

966 - RAM TEST FAILURE. This error code indicates that the unit has failed the periodic RAM test routine.

970 - DIAGNOSTIC LOADER CHECKSUM ERROR. This error code indicates that the monitor has detected a checksum error during the download of the diagnostic program.

977 - ROM CHECKSUM ERROR. This error code indicates that the unit has failed the periodic ROM test routine.

3.4.12 Recalling Prior Data Displays

Pressing the **PRIOR DATA** switch will display the most recently stored determination data with the age of the data, in minutes, displayed steadily in the **CYCLE TIME** window. Even flashing alarms will be stored for recall, although without the accompanying audio alarms. Temperature determinations made in **NORMAL** mode will be stored *without* blood pressure data. Temperature displays in **MONITOR** mode will be stored with each blood pressure determination. Each successive press of the switch will display the next oldest prior data until all the stored results have been displayed, at which time the displays will be blanked, a double beep will sound and the Monitor will exit **PRIOR DATA** mode and the displays will be loaded with the most current determination data. Pressing **CANCEL** or 10 seconds of inactivity will exit **PRIOR DATA** and return to the most current display.There is enough RAM to store the results of up to 100 previous determinations; however, any data that is older than 99 minutes is dropped out of memory.

Note

Switching the monitor **OFF** (then **ON** again) will cause the monitor to clear (erase) all **PRIOR DATA** and Operator set alarm limits. Alarm limits return to Default Readings and the monitor enters the Manual Mode.

3.4.13 Remote Computer Protocol

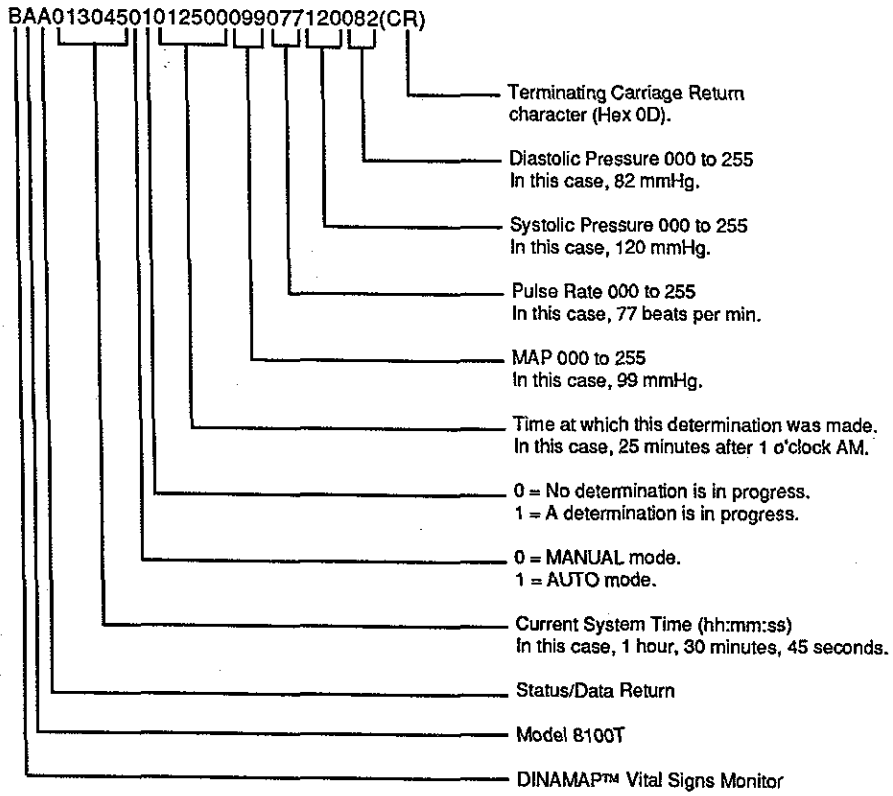
When the monitor is connected to a remote computer (see para. 3.3.3) it can receive and transmit ASCII characters asynchronously at a fixed Baud rate of 600. Word format is 1 START bit, 8 data bits, one STOP bit and no parity. At the serial interface, the monitor identifies 0 volts as a MARK and +5 volts as a SPACE. When power is applied to the monitor, it is placed in receive mode and remains there until the remote computer transmits a valid command. Before transmitting a command, the host computer should transmit an ASCII carriage return to clear the monitor receiver. A valid command is an ASCII character string in one of the following formats:

ASCII FORMAT	COMMAND TYPE
BAA<cr>	Return B.P. Status
BAB<cr>	Start B.P. Determination
BAC<cr>	Return Alternate B.P. Status
BAD<cr>	Return B.P. Alarm Limits
BAE<cr>	B.P. AUTO/MANUAL
BAF<cr>	(reserved for future use)
BAG<cr>	B.P. CANCEL Switch
BAH[t][hhh][lll]<cr>	Change B.P. Alarm Limits
BAI[cc]<cr>	Set CYCLE TIME
BAJ<cr>	Unlock Keyboard
BAK<cr>	Lock Keyboard
DAA<cr>	Return Temperature Status
DAB<cr>	START a NORMAL Temp. Prediction
DAG<cr>	RESET a NORMAL Temp. Prediction
DAH[lll][hhh]<cr>	Change Temp Alarm Limits
DAM<cr>	Change Temp Mode
DAU<cr>	Switch Temp Units (°F to °C/°C to °F)

3.4.13 Remote Computer Protocol Continued

Note that the second character of each command (A) will command only 8100T DINAMAP™ Monitors. Substitute an asterisk (*) for the (A) and the three return status commands will be executed by any model DINAMAP™ monitor.

3.4.13.1 Return B.P. Status Command (BAA). The monitor will respond to a Return B.P.Status Command (BAA) by transmitting a 30-character ASCII string in the following format:


BAA013045010125000990771200 82(CR)
Terminating Carriage Return character (Hex 0D).
Diastolic Pressure 000 to 255 In this case, 82 mmHg.
Systolic Pressure 000 to 255 In this case, 120 mmHg.
Pulse Rate 000 to 255 In this case, 77 beats per min.
MAP 000 to 255 In this case, 99 mmHg.
Time at which this determination was made. In this case, 25 minutes after 1 o'clock AM.
0 = No determination is in progress. 1 = A determination is in progress.
0 = MANUAL mode. 1 = AUTO mode.
Current System Time (hh:mm:ss) In this case, 1 hour, 30 minutes, 45 seconds.
Status/Data Return
Model 8100T
DINAMAP™ Vital Signs Monitor

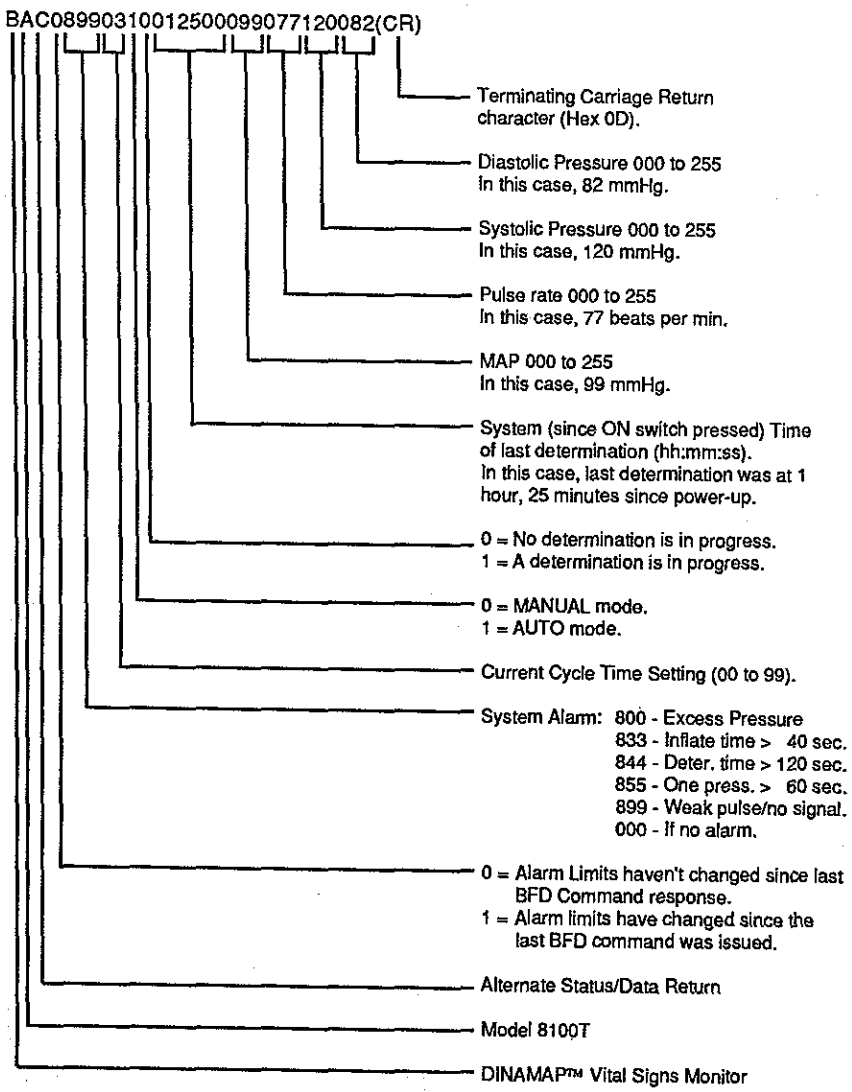
3.4.13.2 Start B.P. Determination Command (BAB). The monitor will respond to a Start Determination Command (BAB) by initiating a blood pressure determination just as though the **START** switch on the front panel had been pressed. There is no data transmission back to the host computer, but subsequent data transmissions in response to a BAA or BAC command will indicate whether or not the determination has begun.

3.4.13 Remote Computer Protocol Continued

If the monitor was in the process of making a blood pressure determination when the host computer issues a BAB command, the command will be ignored.

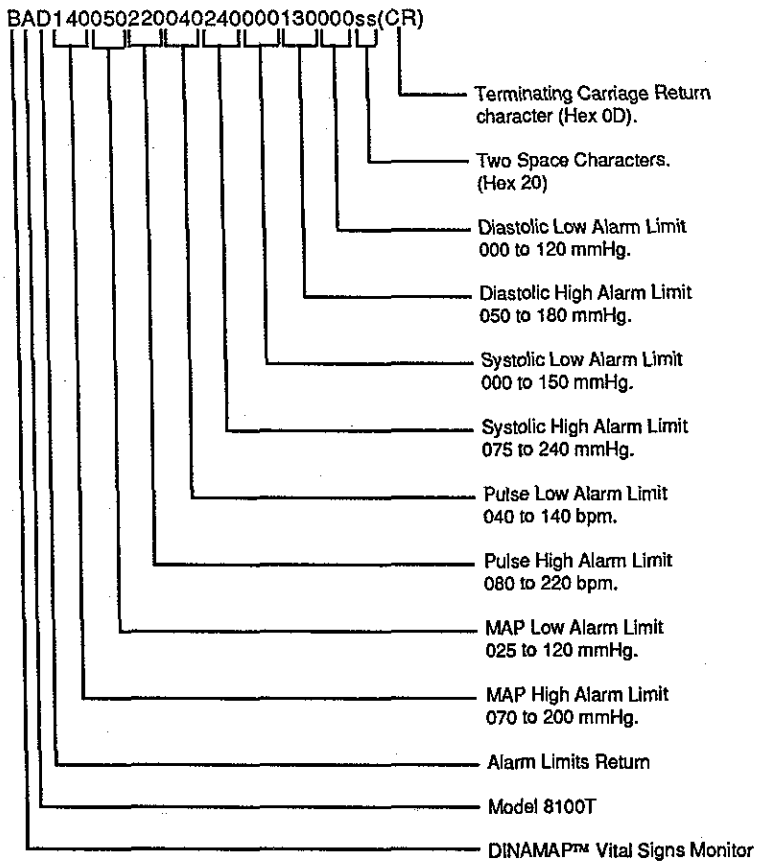
3.4.13.3 Return Alternate B.P. Status Command (BAC).

The monitor will respond to a Return Alternate B.P. Status Command (BAC) by transmitting a 30-character ASCII string in the following format:


BAC089903100125000990771200 82(CR)
Terminating Carriage Return character (Hex 0D).
Diastolic Pressure 000 to 255 In this case, 82 mmHg.
Systolic Pressure 000 to 255 In this case, 120 mmHg.
Pulse rate 000 to 255 In this case, 77 beats per min.
MAP 000 to 255 In this case, 99 mmHg.
System (since ON switch pressed) Time of last determination (hh:mm:ss). In this case, last determination was at 1 hour, 25 minutes since power-up.
0 = No determination is in progress. 1 = A determination is in progress.
0 = MANUAL mode. 1 = AUTO mode.
Current Cycle Time Setting (00 to 99).
System Alarm: 800 - Excess Pressure 833 - Inflate time > 40 sec. 844 - Deter. time > 120 sec. 855 - One press. > 60 sec. 899 - Weak pulse/no signal. 000 - If no alarm.
0 = Alarm Limits haven't changed since last BFD Command response. 1 = Alarm limits have changed since the last BFD command was issued.
Alternate Status/Data Return
Model 8100T
DINAMAP™ Vital Signs Monitor

3.4.13 Remote Computer Protocol Continued

3.4.13.4 Return Alarm Limits Command (BAD). The monitor will respond to a Return Alarm Limits Command (BAD) by transmitting a 30-character ASCII string in the following format:


BAD140050220040240000130000ss(CR)
Terminating Carriage Return character (Hex 0D).
Two Space Characters. (Hex 20)
Diastolic Low Alarm Limit 000 to 120 mmHg.
Diastolic High Alarm Limit 050 to 180 mmHg.
Systolic Low Alarm Limit 000 to 150 mmHg.
Systolic High Alarm Limit 075 to 240 mmHg.
Pulse Low Alarm Limit 040 to 140 bpm.
Pulse High Alarm Limit 080 to 220 bpm.
MAP Low Alarm Limit 025 to 120 mmHg.
MAP High Alarm Limit 070 to 200 mmHg.
Alarm Limits Return
Model 8100T
DINAMAP™ Vital Signs Monitor

3.4.13.5 B.P. AUTO/MANUAL Switch Command (BAE). The monitor will respond to an AUTO/MANUAL Switch Command (BAE) by switching the mode of operation of the monitor. If the mode is being switched to **AUTO**, the monitor will also start a determination.

3.4.13.6 B.P. CANCEL Switch Command (BAG). The monitor will respond to a CANCEL Switch Command (BAE) just as if the front panel **CANCEL** switch was pressed (except for an 800 alarm).

3.4.13 Remote Computer Protocol Continued

3.4.13.7 Change B.P. Alarm Limits Command (BAH). The monitor will respond to this eleven-character command by setting the patient vital sign alarm limits as commanded. The format for this command is:

BAH[t][hhh][lll](Carriage Return).

Where [t] = S for Systolic Limits
D for Diastolic Limits
M for MAP Limits
P for pulse Limits,

where [hhh] = high alarm limit (3 digits, 000 to 255),

and where [lll] = low alarm limit (3 digits, 000 to 255).

3.4.13.8 Set CYCLE TIME Command (BAI). The monitor will respond to this six-character command by setting the new **CYCLE TIME** immediately whether the monitor is in **AUTO** or **MANUAL** mode. If the monitor is in **MANUAL** mode when the **CYCLE TIME** is changed, the new time will take effect when the mode is changed to **AUTO**. The format for this command is:

BAI[cc](Carriage Return).

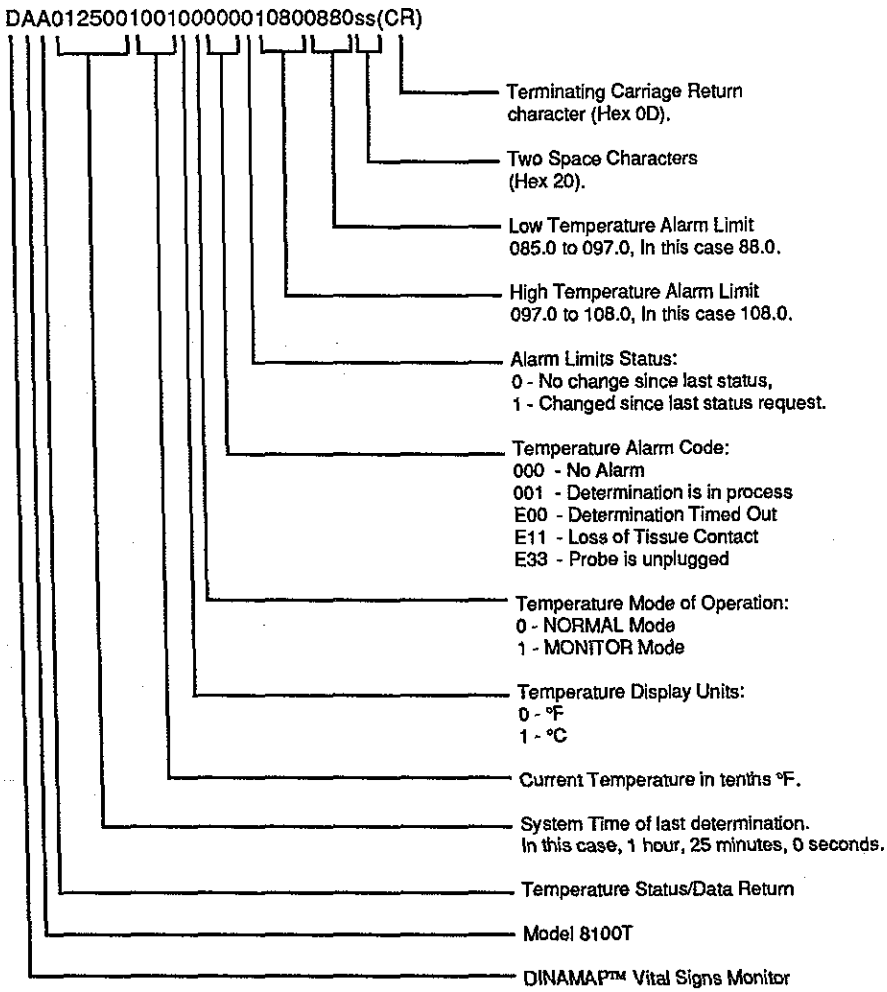
Where [cc] = CYCLE TIME in minutes (2 digits, 00 to 99).

3.4.13.9 Unlock Front Panel Keyboard Command (BAJ). This command will unlock the front panel switches so that control of the monitor can be made manually.

3.4.13.10 Lock Front Panel Keyboard Command (BAK). This command will lock out the front panel switches (except **ON/OFF** switch) so that control of the monitor is allowed only by the host computer.

3.4.13 Remote Computer Protocol Continued

3.4.13.11 Return Temperature Status (DAA). The monitor will respond to a Return Temperature Status Command (DAA) by transmitting a 30-character ASCII string in the following format:


DAA012500100100000010800880ss(CR)
Terminating Carriage Return character (Hex 0D).
Two Space Characters (Hex 20).
Low Temperature Alarm Limit 085.0 to 097.0, In this case 88.0.
High Temperature Alarm Limit 097.0 to 108.0, In this case 108.0.
Alarm Limits Status: 0 - No change since last status, 1 - Changed since last status request.
Temperature Alarm Code: 000 - No Alarm 001 - Determination is in process E00 - Determination Timed Out E11 - Loss of Tissue Contact E33 - Probe is unplugged
Temperature Mode of Operation: 0 - NORMAL Mode 1 - MONITOR Mode
Temperature Display Units: 0 - °F 1 - °C
Current Temperature in tenths °F.
System Time of last determination. In this case, 1 hour, 25 minutes, 0 seconds.
Temperature Status/Data Return
Model 8100T
DINAMAP™ Vital Signs Monitor

3.4.13.12 START a NORMAL Temp. Prediction (DAB). The monitor will respond to a START a NORMAL Temp. Prediction Command (DAB) just as if the front panel **START/RESET** switch were pressed when the monitor is in NORMAL mode.

3.4.13.13 RESET Temperature (DAG). The monitor will respond to a RESET Temperature Command (DAG) just as if the front panel **START/RESET** were pressed. If the monitor is in NORMAL mode and a prediction is in process, this command will abort the prediction. If the monitor is in MONITOR mode, this command will cancel and disable any temperature limit alarms for a period of two minutes.

3.4.13 Remote Computer Protocol Continued

3.4.13.14 Change Temp Alarm Limits Command (DAH). The monitor will respond to this twelve-character command by setting the patient temperature alarm limits as commanded. The format for this command is:

DAH[llll][hhhh]<cr>

where [llll] = low alarm limit (4 digits, 85.0° F to 97.0° F)

and where [hhhh] = high alarm limit (4 digits, 97.0° F to 108.0° F)

3.4.13.15 Change Temp Mode (DAM). The monitor will respond to a Change Temp Mode Command (DAM) just as if the **TEMPERATURE NORMAL/MONITOR** switch on the front panel were pressed.

3.4.13.16 Switch Temp Units (DAU). The monitor will respond to a Switch Temp Units Command (DAU) just as if the front panel **°F/°C** switch were pressed.

3.4.14 Battery Removal and Replacement

Under normal conditions the battery should last two years. It is best to keep the battery charged as fully as is practical and never store the monitor with the battery in a discharged condition. When the battery will no longer take a charge, remove it and replace it with one of the same part number as outlined below:

1. Ensure that AC power is removed from the monitor by unplugging the power cord, if attached. On the international units with an AC power switch on the back, also place the switch in the **"O"** position.

2. Using a dime, or similar tool, loosen the battery door hold-down screws as shown in Figure 3-6. Turn each screw counterclockwise at least one and one-half turn.

3. Place both thumbs over the knurled portions of the battery door and push the door out and away from the monitor case as shown in Figure 3-7.

3.4.14
Battery Removal and Replacement
Continued

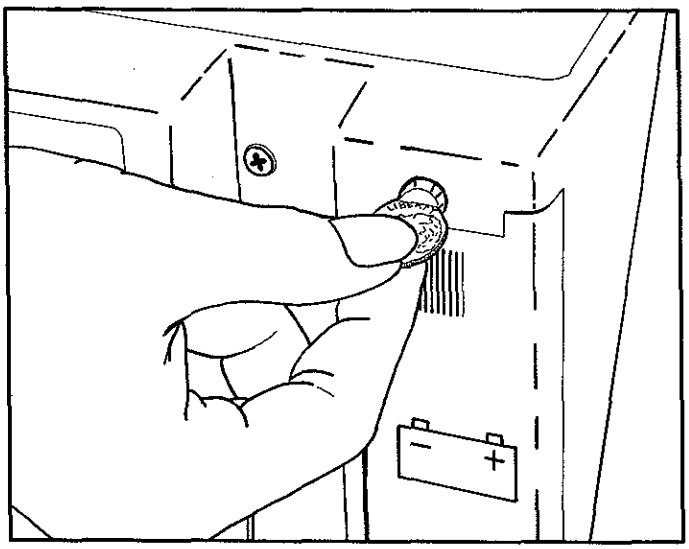


Figure 3-6. Loosen the Battery Door Hold-Down Screws

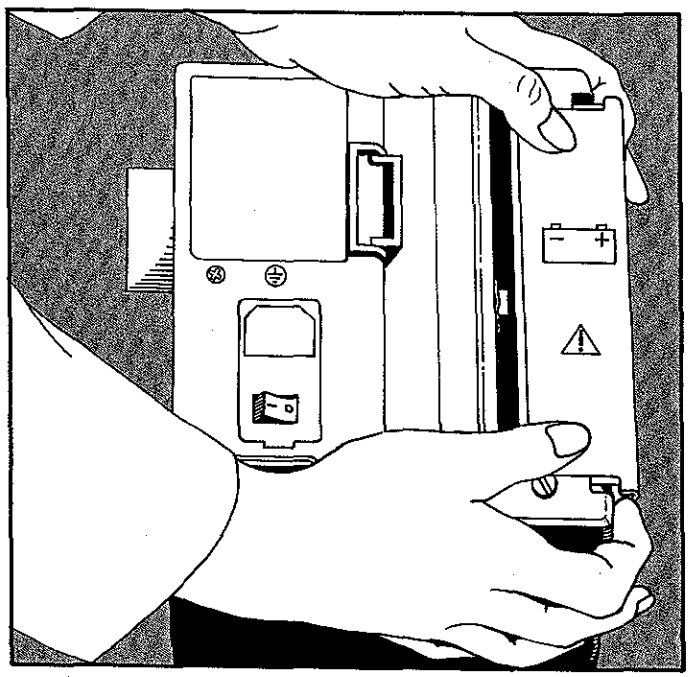


Figure 3-7. Remove Battery Door

3.4.14
Battery Removal and Replacement
Continued

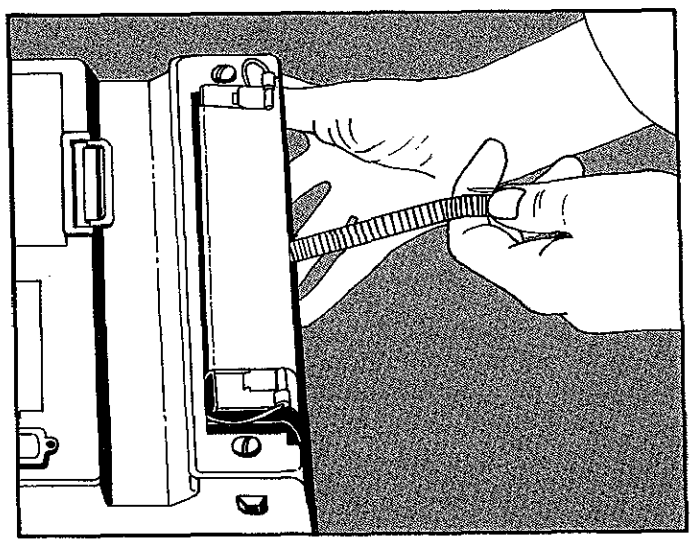


Figure 3-8. Remove Battery

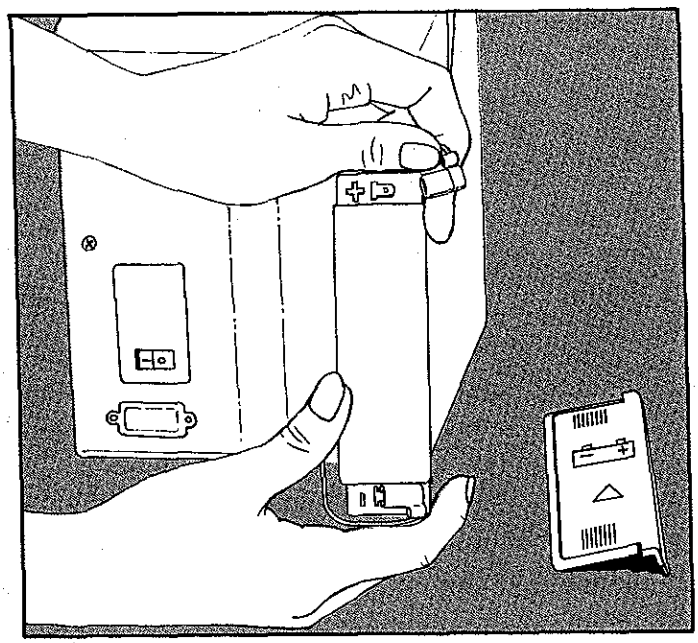


Figure 3-9. Remove Battery Cable Connectors

3.4.14
Battery Removal and Replacement
Continued

4. Locate the nylon ribbon and use it to pull the battery out of its compartment as shown in Figure 3-8. The battery is held securely in its compartment by friction-lock material strips and a firm, steady pull on the ribbon is required to pull the battery free.

5. When the battery is free, remove the battery cable spade-lug connectors as shown in Figure 3-9.

6. Connect the battery cable spade-lug connectors to the new battery, ensuring proper polarity. Connect the red battery cable to the positive (+) terminal. Connect the black battery cable to the negative (-) terminal.

7. Pull the nylon ribbon out as far as it will come to the right of the monitor case and insert the new battery (positive terminal up and out) over the ribbon, pushing it into the battery compartment as far as it will go.

8. Fold the loose end of the ribbon over the battery and slide the battery compartment cover into its slots over the battery until it is flush with the case.

9. Tighten the battery cover hold-down screws.

10. Connect the AC power cord to the back of the monitor and plug it into an appropriate AC outlet. On the international units that have an AC power switch on the back, place the switch in the "I" position.

11. Charge the new battery for at least 16 hours before using the monitor on battery power alone.

SECTION 4. PRINCIPLES OF OPERATION

4.1 INTRODUCTION

This section of the manual presents the principles of operation for the Model 8100T Vital Signs Monitor. First, the functional modules comprising the Model 8100T are located, their functions described, and their interconnections shown. Then, the operation of the circuitry is described sufficiently to allow troubleshooting to the component level using the internal diagnostics.

4.2 FUNCTIONAL MODULES AND INTERCONNECTIONS

The Model 8100T comprises nine functional modules designed for easy trouble isolation and replacement in the field. Figure 4-1 shows the location of these modules with the rear case cover removed. These modules are:

- the AC Connector Assembly
- the Transformer Assembly
- the Battery Assembly
- the Power Supply Printed Wiring Assembly
- the CPU Printed Wiring Assembly
- the Front Switch Panel
- the Display Printed Wiring Assembly
- the Pneumatics Module Printed Wiring Assembly
- the Pump Assembly

A connection diagram showing the interconnections of these modules is shown in Figure 4-2. The function of each module is described in following paragraphs.

4.2.1 AC Connector Assembly

AC line power enters the instrument through the AC connector assembly (also called the power entry module) which comprises a grounded line cord connector, fuse holder, and line filter. When the line cord is connected to the AC connector and plugged into an appropriate AC outlet, AC power is applied to the monitor electronics and to the internal battery charger. When AC power is disconnected the monitor operates on the internal battery. Both sides of the AC line are fused and the fuses are accessible by removing the power cord and lifting the hinged cover.

4.2.2 Transformer Assembly

The transformer assembly consists of a power transformer and a metal oxide varistor (MOV) connected across the primary taps acting as an overvoltage protector. The power transformer, T1, is a custom design of which there are two versions, one for 230 volt nominal input and one with primary taps for 100 and 120 volts nominal input. Both are specified for 50 and 60 Hz nominal frequencies. The MOV protects the instrument from voltage transients on the incoming power.

4.2.3 Battery Assembly

The battery assembly (AS 320-378) consists of a 12 V lead acid battery, a reorder label and two adhesive Velcro pads used to secure the battery in its slot in the monitor frame. The battery is connected to the power supply via the cable assembly (AS 316-310) which connects to the battery terminals with spade-lug connectors and to the power supply via a 4-pin connector at J1.

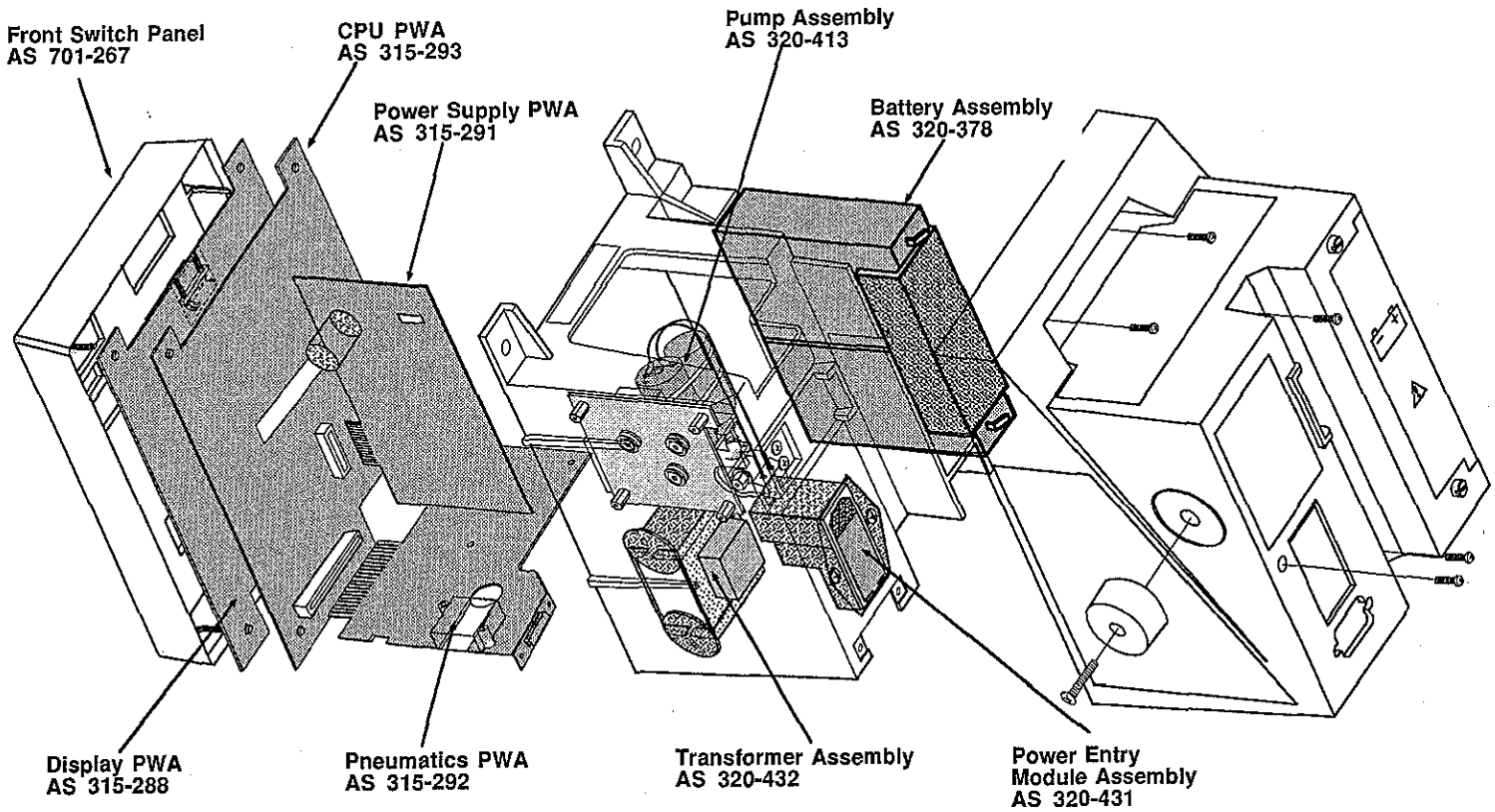


Figure 4-1. Model 8100T Functional Module Locations

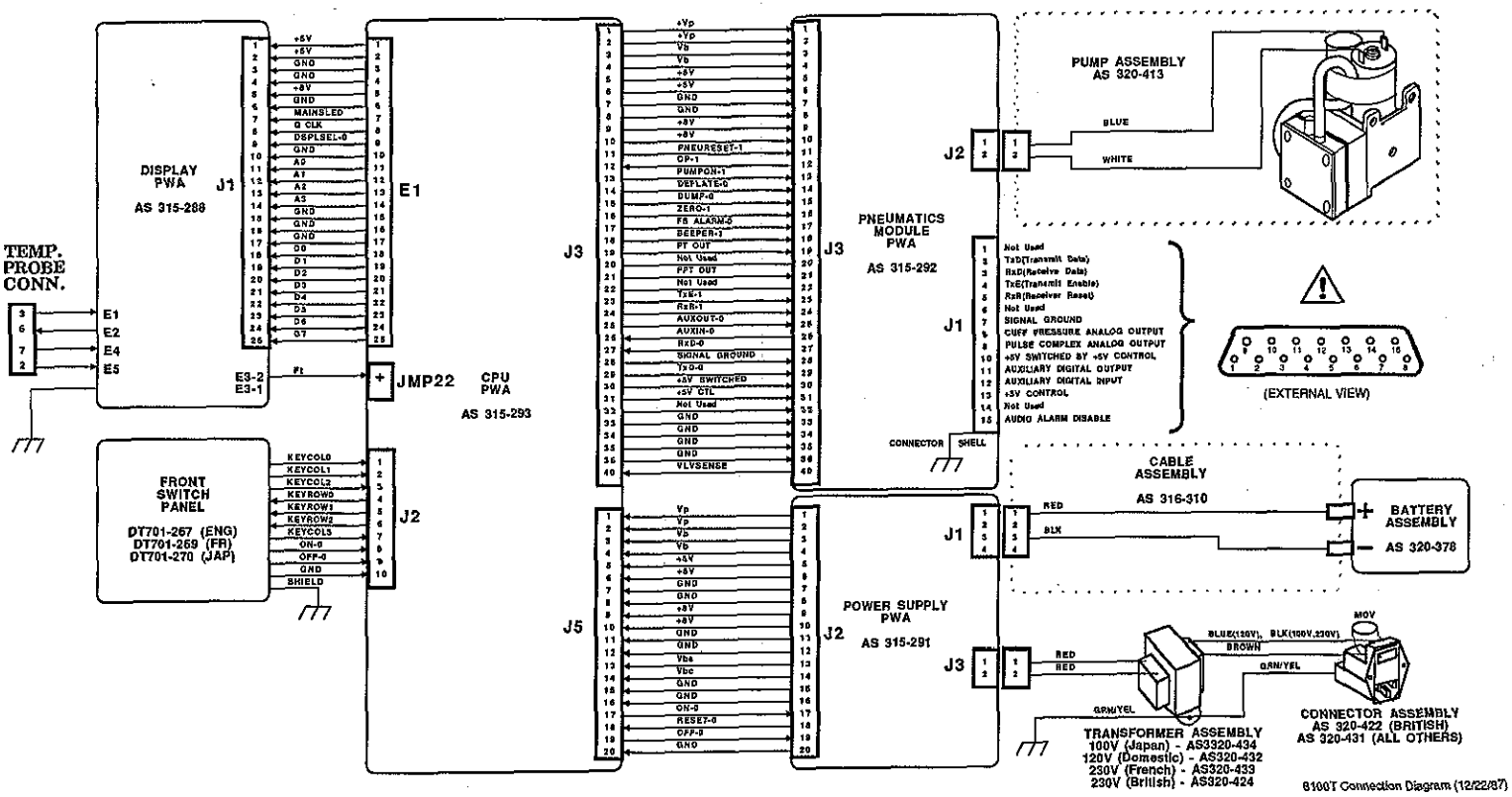


Figure 4-2. Model 8100T Connection Diagram

4.2.4 Power Supply Printed Wiring Assembly

The Power Supply printed wiring assembly (AS 315-291) is mounted vertically in the monitor frame and plugs into the CPU board card-edge connector, J5. The battery is connected to the power supply via J1. AC power from the transformer assembly is brought into the power supply at J3. Figure 4-3 identifies the connectors, test points and adjustments on the power supply board. Two adjustments are provided at the top edge of the board. R12 adjusts the battery float voltage. R13 adjusts the voltage output of the +5 Vdc logic supply.

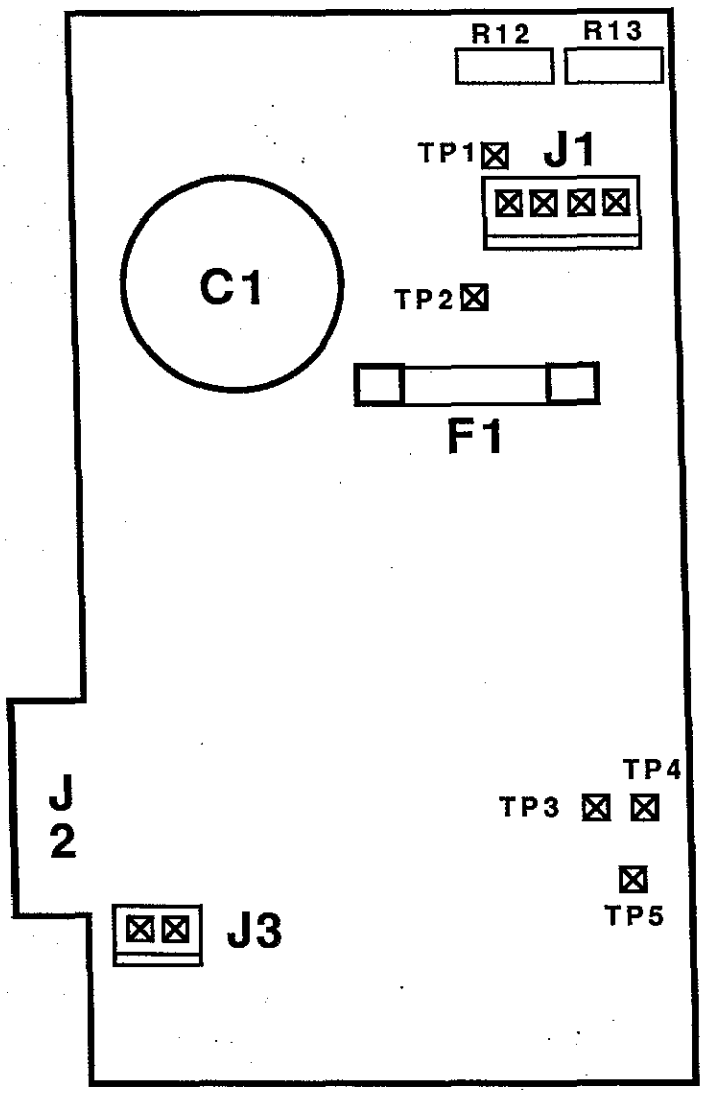


Figure 4-3. Power Supply Connectors, Adjustments and Test Points

4.2.4
Power Supply
Printed Wiring Assembly
Continued

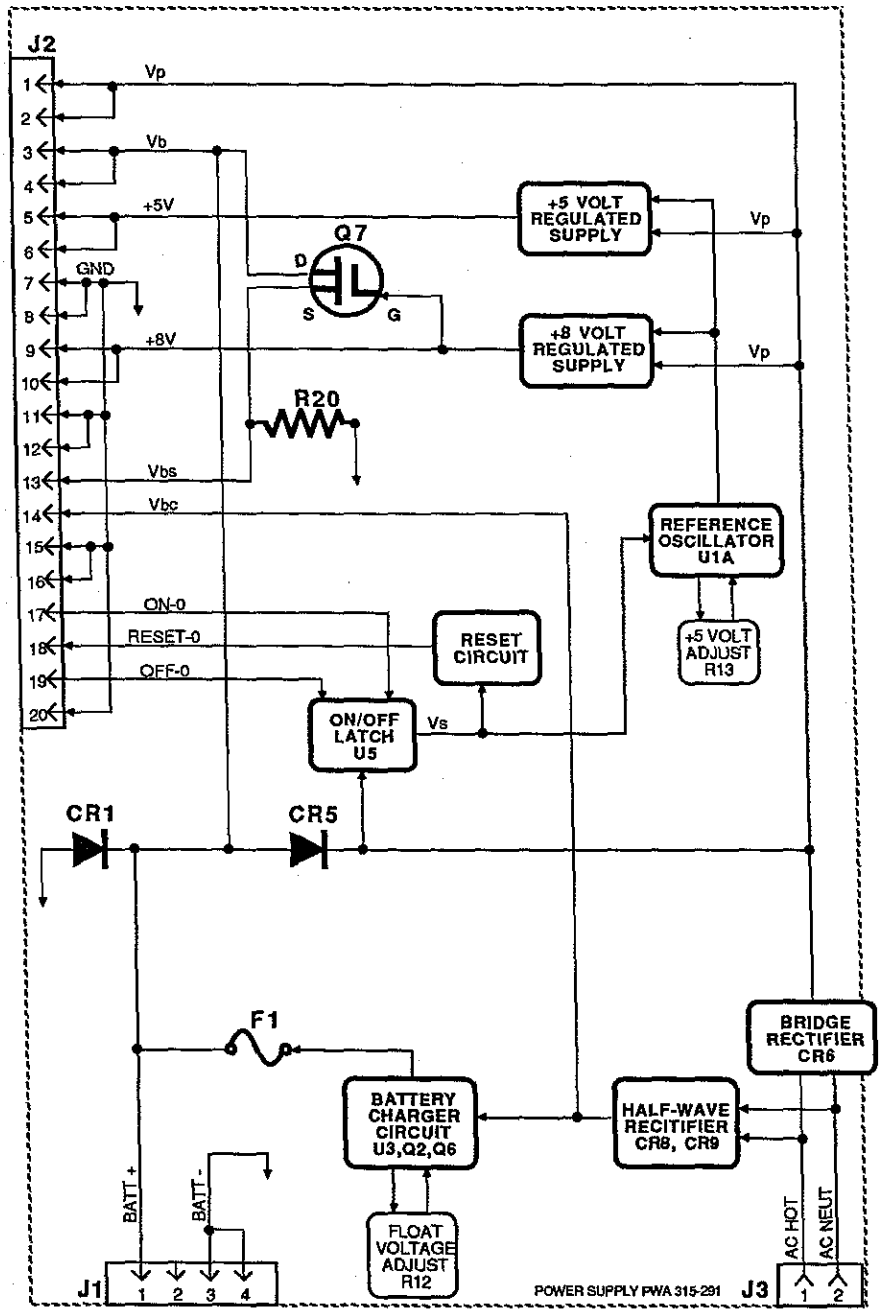


Figure 4-4. Power Supply Functional Block Diagram

4.2.4
Power Supply Printed Wiring Assembly
Continued

A functional block diagram of the circuits contained on the power supply\board is shown in Figure 4-4. The ON and OFF switches on the front panel are routed through the CPU board directly to the ON/OFF latch on the power supply board. When the ON switch is pressed, the latch is set and applies power (Vs) to the reference oscillator for the +5V and +8V supplies and also triggers the RESET circuit which raises the RESET-0 signal to +5 V approximately 50 milliseconds after power on. The +5V and +8V switching power supplies are controlled by the reference oscillator (adjusted by R13) and powered by Vp. Vp is derived from the AC brought in from the power transformer and rectified by CR6 or from the battery through CR5. The AC power is also rectified by CR9 and CR10 to derive Vbc which is regulated by the battery charger circuit (adjusted by R12) to produce Vb through the battery fuse, F1. Vb is applied across R20 by Q7 when the monitor is ON to produce Vbs which is monitored by the A-to-D converter on the CPU board (R20 dividing the battery voltage down to the input range of the A-to-D). For a detailed description of these functional circuits, refer to paragraph 4.3.

4.2.5
CPU Printed Wiring Assembly

The CPU printed wiring assembly (AS 315-293) is mounted on standoffs behind the display board on the bezel assembly and is connected to the display board by a compression connector at E1. The switchpanel printed circuit connector is connected to the CPU board via a right angle pin connector at J2. Figure 4-5 identifies the connectors, test points and adjustments on the CPU board. Three adjustments are provided on the board. R48 adjusts the precision reference voltage supply. R20 adjusts the scale of the pressure transducer output. R33 adjusts the zero output level of the pressure transducer. The test points are identified as follows:

TEST POINT	SIGNAL ASSIGNMENT
TP1	Master Clock (3.6864 MHz)
TP2	Read/Write Line Generated by CPU
TP3	E Clock (0.9216 Mhz) Generated by Gate Array (U2)
TP4	Q Clock (0.9216 Mhz) Generated by Gate Array (U2)
TP5	FIRQ (2 MHz Interrupt Request) Generated by Gate Array (U2)
TP6	UCLK (1.8432 MHz USART Clock) Generated by (U2)
TP8	DMANB (Fail-safe Timer Reset) Generated by Gate Array (U2)
TP9	Fail-safe Timer Time-out
TP10	Analog Ground
TP11	VREF (Set by R48 to 4.50 Vdc)
TP13	FPT (Filtered Pressure Transducer) Analog Signal
TP16	Negative Voltage Source (-6.2Vdc)
TP17	Pressure Transducer Excitation Voltage (PTEXV)
TP18	Pressure Transducer Zero Bias (0.90 Vdc)

4.2.5
CPU
Printed Wiring Assembly
Continued

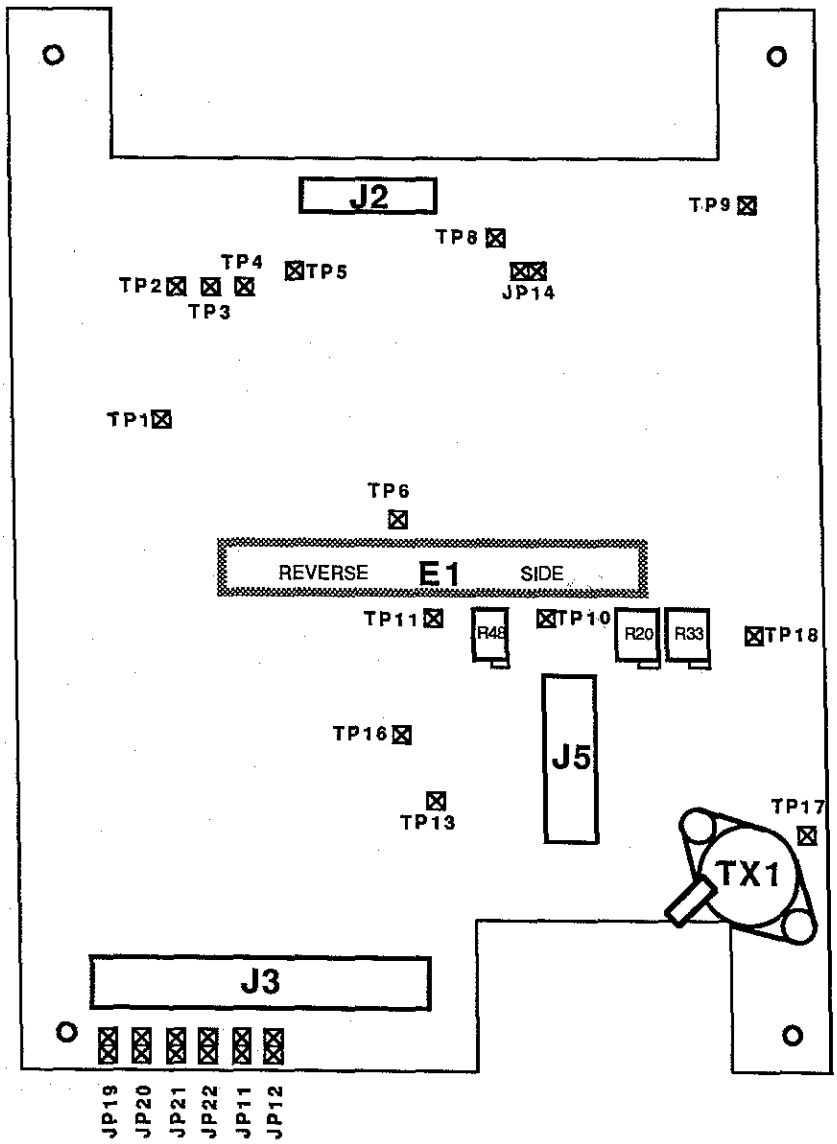


Figure 4-5. CPU Connectors, Jumpers and Test Points

4.2.5
CPU
Printed Wiring Assembly
Continued

A functional block diagram of the circuits contained on the CPU board is shown in Figure 4-6. This functional description is confined to the interface signals between the CPU board and the functional modules connected to it.

The **front switch panel** is connected to the CPU board at J2. The ON and OFF switches are brought into the CPU board and connected directly to the power supply at J5. Pressing either switch pulls the respective signal line to ground to set or reset the ON/OFF latch on the power supply board. All the rest of the front panel switches are wired in a matrix which is interrogated and read by the microprocessor through discrete digital I/O bits in the A-to-D converter. The digital output lines, KEYROW0, KEYROW1 and KEYROW2, are sequentially strobed approximately every 2 milliseconds by the microprocessor as a foreground task. As each line is strobed, the microprocessor reads each digital input line, KEYCOL0, KEYCOL1, KEYCOL2 and KEYCOL3 to determine which, if any, keyswitch is pressed. The switchpanel matrix is shown in Figure 4-7.

The **power supply** is connected to the CPU board at J5. Unregulated pump voltage, Vp, is brought into the CPU board and routed directly to the pneumatics module at J3. Battery voltage, Vb, is also brought into the CPU board and routed directly to J3. The +5Vdc is used on the CPU board as the logic supply, sampled by the microprocessor through the A-to-D converter, routed to connector E1 for the display board logic supply, and routed to J3 for the pneumatic module logic supply. The +8 Vdc is used by the analog circuits on the CPU board, sampled by the microprocessor through the A-to-D converter, used as a voltage source for the -6Vdc supply, and routed to the pneumatic module at J3 for use in the audio alarm and valve actuator circuits. The sampled battery voltage (Vbs) is the battery voltage applied across a voltage divider in the power supply and brought into the CPU board to be sampled by the microprocessor through the A-to-D converter. The battery charger voltage (Vbc) is brought into the CPU board to be sampled by the microprocessor through the A-to-D converter. The master reset signal (RESET-0) is produced on the power supply board and used on the CPU board to reset the microprocessor, the A-to-D converter, the fail-safe timer, the serial receiver/transmitter and the pneumatic module through the pneumatic reset circuit.

The **display board** is interfaced to the CPU board at E1 which is a compression connector sandwiched in between the CPU and display boards. The display board is an output device which receives display data via the microprocessor data bus (D0 - D7). The microprocessor writes display data to the display board as a foreground task in response to the FIRQ interrupt. The individual displays on the display board are addressed by DSPSEL- 0 and the low order address bits (A0 - A3). The data transfers are synchronized by Q CLK. The **MAINS AC (RECHARGE)** LED on the display board is lighted by a discrete signal (MAINSLED) which is derived from a voltage divider across the battery charger voltage (Vbc) on the CPU board.

4.2.5
CPU
Printed Wiring Assembly
Continued

The **pneumatic module** is interfaced to the CPU board at J3 which comprises power and signal connections for the audio alarm, valve control, fail-safe interlock, and overpressure detection circuits. The ZERO-1, DUMP-0, DEFLATE-0, PUMPON-1 and BEEPER-1 signals are discrete digital signals generated by the CPU to control the pneumatic valves, air pump, and audio alarm, respectively.

The audio alarm signal, BEEPER-1, is a pulse-modulated signal which turns on the fixed-frequency audio alarm on the pneumatics board and controls the volume of the alarm as a function of the signal duty cycle.

The overpressure signal, OP-1, is generated by the pneumatic board when the cuff pressure rises to approximately 310 mmHg (the trigger point may be between 265 mmHg and 355 mmHg) and is read by the CPU as a digital input through the A-to-D converter.

The pneumatic system reset signal, PNEURESET-1, is generated on the CPU board in response to a power OFF/ON sequence or the pressing of the front panel CANCEL switch and is used to reset the overpressure latch on the pneumatics board and cancel the 800 alarm.

The fail-safe alarm signal, FS ALARM-0, is generated on the CPU board in the event of a microprocessor failure and is sent to the pneumatics board to open the DUMP and DEFLATE valves and disable the air pump.

The pump voltage, Vp, is the unregulated voltage developed on the power supply board and routed directly through the CPU board to J3. The +5 Vdc is the logic supply. The +8 Vdc is the voltage supply for actuating the pneumatic valves and the audio alarm circuit. The battery voltage, Vb, is not used on the pneumatic board. The valve current sense line, VLVSENSE, is an average voltage across all three pneumatic valves which is read through the A-to-D converter during manufacturing tests and is indicative of the current drain through the valves (it is not used by the monitor software during normal operation of the unit).

Transmit Enable (TxE-1), Receiver Reset (RxR-1), and Auxiliary Output (AUXOUT-0) are discrete digital output signals generated by the CPU through the gate array and routed to the communications connector on the pneumatic board for use by an external serial interface. Auxiliary Input (AUXIN-0) is a discrete digital input read by the microprocessor through the gate array from the external serial interface. Transmit Data (TxD-0) and Receive Data (RxD-0) are +5Vdc logic level serial communication signals generated and received respectively by the UART(U6).

Analog output signals representative of the cuff pressure (PTOUT) and the pulse oscillations (FPTOUT) are routed through the pneumatics board to the external communications connector for connection to a strip chart recorder or other analog device. The +5VCTL line allows an external device, such as a serial communications interface to switch a +5Vdc supply voltage (+5VSWITCHED) to the external device.

4.2.6 Front Switch Panel

The front switch panel is a matte finish polycarbonate panel sandwiched to a printed circuit containing dome switches used for all the front panel controls. The dome switches are connected to the CPU board by a printed circuit connector which is fed through a slot on the front bezel and connected to J2 of the CPU board by a right angle connector. A functional block diagram of the switch panel is shown in Figure 4-7.

Pressing the ON or OFF switch pulls pin 8 or pin 9 , respectively, to ground (pin 10). These lines are brought into the CPU board at J2 and are routed directly to the power supply board through J5 where they are used to set and reset the ON/OFF latch.

All the rest of the front panel switches are wired in a matrix as shown in Figure 4-7. This matrix is interrogated periodically by the CPU through digital output bits in the A-to-D converter. KEYROW0, KEYROW1 and KEYROW2 are sequentially strobed as a foreground task in response to the FIRQ interrupt (2 milliseconds). After each strobe, the CPU reads the state of KEYCOL0, KEYCOL1, KEYCOL2 and KEYCOL3 as discrete digital input bits to the A-to-D converter to determine which switch, if any, is pressed.

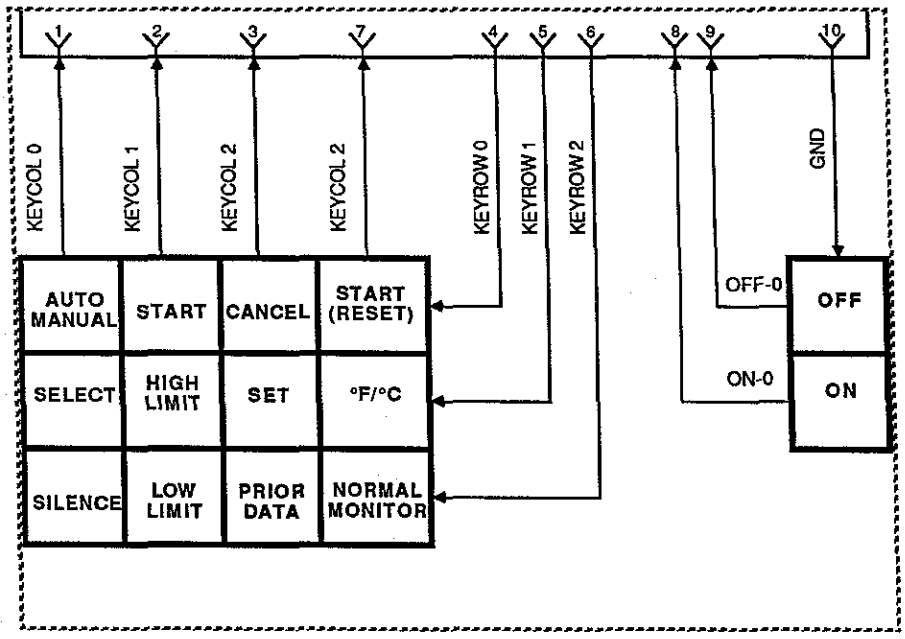


Figure 4-7. Switch Panel Functional Block Diagram

4.2.7 Display Printed Wiring Assembly

The display printed wiring assembly (AS 315-288) is mounted on the rear of the front bezel and connected to the CPU board at J1 by a compression connector which is sandwiched between the two boards. A functional block diagram depicting the signal interface between the display board and the CPU board and the functional circuits on the display board is shown in Figure 4-8. The functional circuits provide for data output transfers from the CPU data bus to the display board, transfer of the data and LED select information to the LED driver circuits, a timing circuit to prevent ghosting and scan failures, and temperature detection and patient isolation circuits for the front bezel-connected temperature probe.

Data transfers are enabled by DSPLSEL-0 and synchronized by Q CLK. DSPLSEL-0 is asserted by the gate array on the CPU board any time the CPU addresses in the range of 0800H to 08FFH. QCLK is generated by the gate array for CPU and I/O transfers and is used here to latch the address and data for the specified LED display. The address and data are defined for the display board as follows:

Hex. Adr.	Sel. LED	Front Display	Data Bus D0	D1	D2	D3	D4	D5	D6	D7
0800	DS33	Systolic Units	seg a	seg b	seg c	seg d	seg e	seg f	seg g	seg h
0801	DS3	Systolic Tens	"	"	"	"	"	"	"	"
0802	DS19	Systolic Hundreds	"	"	"	"	"	"	"	"
0803	DS30	Temp. Tenths	"	"	"	"	"	"	"	"
0804	DS16	Temp. Units	"	"	"	"	"	"	"	"
0805	DS34	Temp. Tens	"	"	"	"	"	"	"	"
0806	DS10	Diastolic Units	"	"	"	"	"	"	"	"
0807	DS18	Diastolic Tens	"	"	"	"	"	"	"	"
0808	DS17	Diastolic Hundreds	"	"	"	"	"	"	"	"
0809	DS8	Pulse Units	"	"	"	"	"	"	"	"
080A	DS5	Pulse Tens	"	"	"	"	"	"	"	"
080B	DS7	Pulse Hundreds	"	"	"	"	"	"	"	"
080C	DS32	Cycle Units	"	"	"	"	"	"	"	"
080D	DS1	Cycle Tens	"	"	"	"	"	"	"	"
080E	Point	LED's	silenc	T100	T100	prior	auto	manu	norm	monit
080F	Point	LED's &Temp Select	°F	°C	CUFF	kPaD	kPaS	BATT	SEL0	SEL1

The **scan failure protection circuit** protects each LED from being overdriven in the event of a microprocessor failure to update the display. If the DSPLSEL-0 signal ceases to be asserted, the scan failure circuit will inhibit the digit select circuits before 20 milliseconds elapse.

The **ghosting prevention circuit** delays the assertion of the digit select circuit by up to 13 microseconds to compensate for propagation delays and, thus, ensuring that the right data is applied to the selected LED.

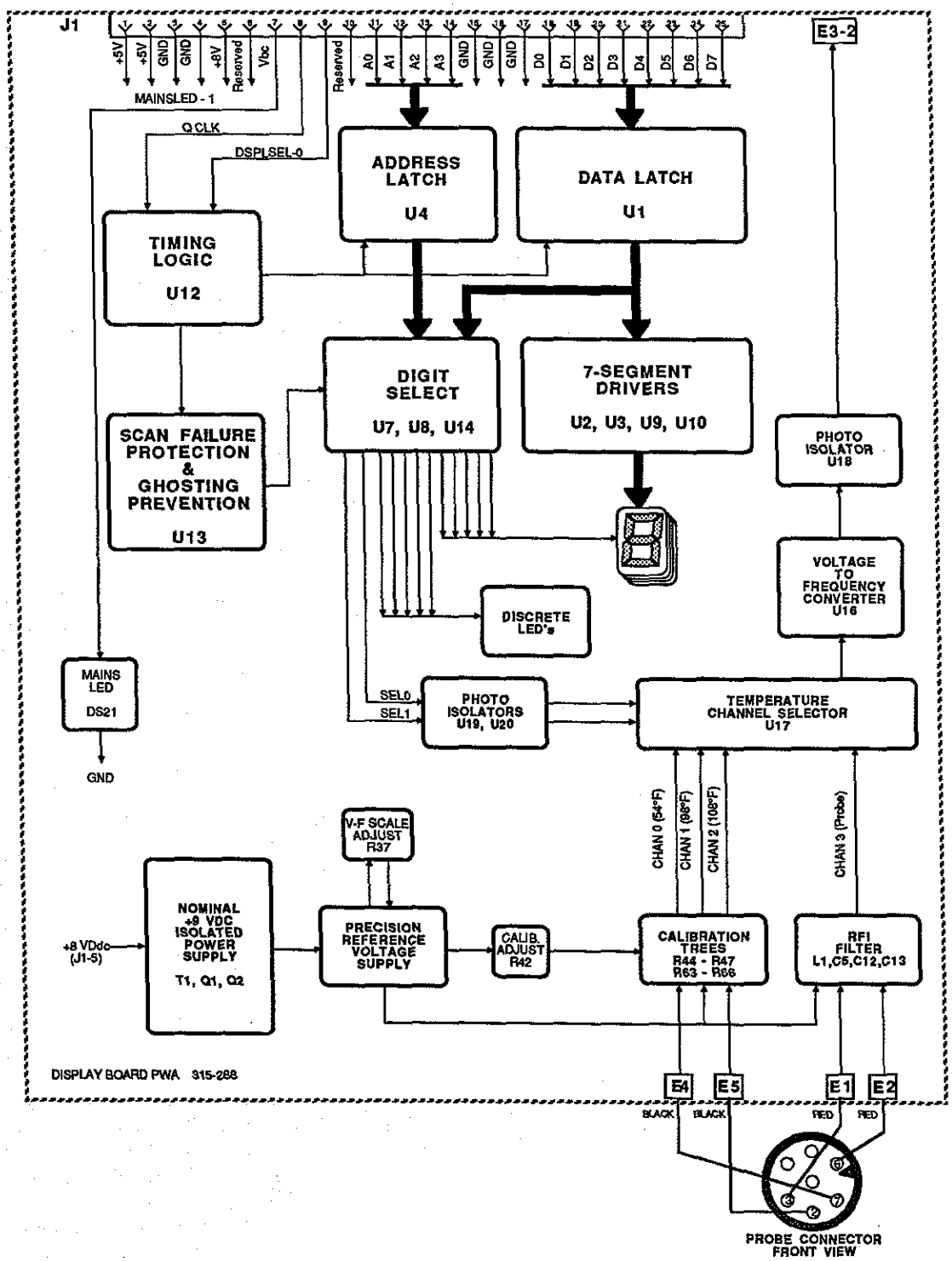


Figure 4-8. Display Board Functional Block Diagram

4.2.7
Display
Printed Wiring Assembly
Continued

Temperature detection is effected by a fully isolated precision voltage reference supply feeding the calibration trees and the temperature probe thermistor. The temperature probe connector receptacle is hard-wired into the display board and physically mounted on the front panel bezel. When the temperature probe is connected, the thermistor is placed across E1 and E2 and, if it is a rectal probe (red), a jumper is connected across E4 and E5. The thermistor exhibits a negative temperature coefficient and is connected into a resistor network that is biased by a precision reference voltage supply, adjusted by R37 at the bottom of the board. The output of the network is a voltage that varies proportionally with temperature and linearly in the range of normal human body temperature. Nonlinearities outside this range are corrected in software. This voltage is applied to an analog multiplexer as channel 3. The other three channels are reference voltages derived from the same excitation voltage source as the thermistor network (trimmed by R42) and are selected by the software periodically to perform auto calibration. The output of the multiplexer is applied to the voltage-to-frequency converter whose square-wave output is applied to the CPU board as a digital input at JMP22 through the photo isolator and E3-2.

4.2.8
Pneumatics
Printed Wiring Assembly

The pneumatics printed wiring assembly (AS 315-292) is mounted horizontally on the bottom of the frame and plugs into connector J3 of the CPU board. Connector J1 on the pneumatics board is the external communications connector. Connector J2 in the middle of the board is the air pump connector. A functional block diagram of the circuits and the pneumatic system is shown in Figure 4-9.

The **pneumatic system** comprises the cuff and hose, the solenoid-operated pneumatic valves and the overpressure switch on the pneumatics printed wiring assembly, the air pump assembly, and the pressure transducer on the CPU board. The air pump assembly pumps air into the normally-open port of the DUMP valve (MT3). In the de-energized state, the DUMP valve normally-open port is connected to the common port which feeds the cuff pressure manifold. Connected to the cuff pressure manifold are the overpressure switch, the cuff output port and the DEFLATE valve. The pneumatic hose to the overpressure switch has a restrictor installed to reduce pressure transients which may cause a false triggering of the switch which is set to trigger between 265 mmHg and 355 mmHg. When an overpressure condition occurs, the switch opens to raise the OP-1 signal which forces the interlock circuit to energize the DUMP valve, de-energize the DEFLATE valve, and turn off the pump. The DEFLATE valve ports the pressure manifold through the normally-open port to the common port and then to atmosphere through an inline restrictor which facilitates small deflation steps. The other cuff connector is ported through the normally-open port of the ZERO valve to the common port which is connected directly to the pressure transducer on the CPU board. During an auto-zero operation, the CPU energizes the ZERO valve to port the pressure transducer to atmosphere through the normally-closed port and interprets the output of the A-to-D converter to be 0 mmHg.

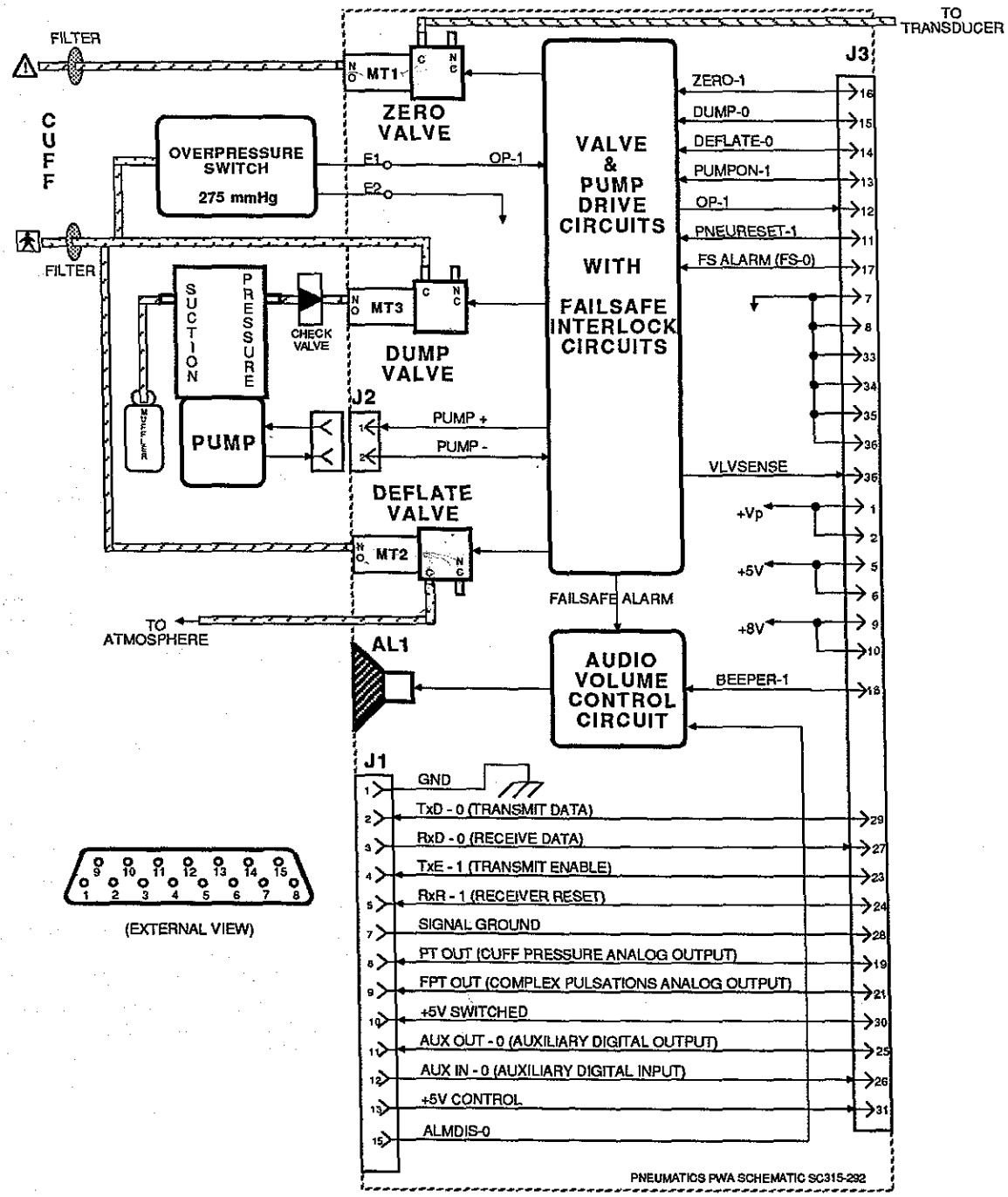


Figure 4-9. Pneumatics Board Functional Block Diagram

4.2.8
Pneumatics
Printed Wiring Assembly
Continued

The **pneumatic valve control signals** (ZERO-1, DUMP-0, DEFLATE-0) are generated on the CPU board and cause the valves to energize when asserted. Only the DUMP and DEFLATE valves are interlocked by the fail-safe alarm (FS-0) and the overpressure signal (OP-1) so that the DUMP valve is energized and the DEFLATE valve is de-energized should a fail-safe alarm or overpressure condition occur.

The **air pump control signal**, PUMPON-1, is generated by the CPU board and enables the pump drive circuit which regulates Vp to drive the pump. PUMPON-1 is gated in the interlock circuit by DEFLATE-0 and FS ALARM-0 and OP-1 so that the pump is turned off during a deflate or when an overpressure or fail-safe condition occurs.

The **overpressure signal**, OP-1, is sent to the CPU board where it is read as a digital input bit and used to generate the 800 alarm.

The **pneumatic system reset signal**, PNEURESET-1, is generated on the CPU board by a system reset (power on) or an activation of the CANCEL switch on the front panel. When either condition occurs, the overpressure latch in the interlock circuit is reset to deactivate the OP-1 signal.

The **fail-safe alarm signal**, FSALARM-0, is generated on the CPU board should the microprocessor fail and is used in the fail-safe interlock circuits to disable the pump drive, de-energize the DEFLATE valve, energize the DUMP valve and enable the audio control circuit to sound the highest volume, continuous alarm.

The **valve sense line**, VLVSENSE, is used to measure the current drain of the valve solenoids during final test in manufacturing and is not used in the normal operation of the monitor.

The **audio alarm enable signal**, BEEPER-1, is generated on the CPU board to enable the constant frequency audio alarm. The signal is pulse modulated to control the volume of the audio alarm.

All the signals on J1 are described in the functional description of the CPU board except the audio **alarm disable signal**, ALMDIS-0. This line allows the audio alarm circuit to be disabled externally by pulling pin 15 of the external communications connector to ground (pin 1). This is provided for test and calibration purposes and care should be taken not to unintentionally disable the alarm.

4.2.9 Pump Assembly

The air pump assembly consists of a bellows type pump with integral motor and eccentric drive, an intake muffler, a check valve, an electrical connection cable with snap-lock connector, rubber tubing, and a shock mounted bracket with standoffs. The air pump assembly mounts on the inside of the frame just above the AC transformer assembly and is electrically connected to J2 of the pneumatics board. The rubber tube connected to the pressure port of the pump is connected to the normally-open port of the DUMP valve (MT3) on the pneumatic board.

4.3 POWER SUPPLY OPERATION

The power supply circuits are shown on schematic SC315-291 contained in Section 6. The circuits are divided into 5 functional circuits;

- the unregulated air pump supply,
- the regulated +5 Vdc and +8 Vdc supplies,
- the on/off control and low battery shutdown circuit,
- the logic system master reset circuit, and
- the battery charger circuit.

4.3.1 Unregulated Air Pump Supply

The unregulated air pump supply voltage appears across filter capacitor C1 and is supplied to the Pneumatics Module PWA through the CPU PWA as Vp. This supply is fed from the battery through CR5 and from the line power transformer through bridge rectifier CR6. When line power is applied, Vp is higher than the battery voltage and reverse biases CR5. When line power is not applied, Vp is provided by the battery through CR5 with the rectifiers in CR6 isolating the transformer. Vp varies from about 10 Vdc with a nearly discharged battery to about 32 Vdc with high line voltage and low load.

4.3.2 Regulated +5 and +8 Vdc Supplies

These regulated supplies are provided by pulse width modulated step-down switching regulators. In this type of regulator a switching device generates a pulse with a peak value nearly equal to the input voltage, a minimum value nearly equal to zero, and an average value equal to the desired output voltage. This pulse waveform is then passed through a reactive (lossless) lowpass filter to remove switching frequency components and pass the average DC signal as the output voltage. In a closed loop regulator such as this the output voltage is compared to a reference voltage and the duty cycle is varied to adjust the output to the desired voltage in response to input voltage and output load variations.

U1 is a quad voltage comparator with open collector outputs. U1A comprises an astable multivibrator, called the reference oscillator, which establishes the switching frequency and output voltages of the +5 and +8 Vdc supplies. U1B controls the +5 Vdc output transistor and U1D controls the +8 Vdc output transistor. U1C is unused.

4.3.2
Regulated
+5 and +8 Vdc Supplies
Continued

Q4 is the switching device for the +5 Vdc supply and is driven on and off by the output of U1B. During the on part of the cycle the collector of Q4 is switched to Vp, less the on drop of the transistor (about 1 Vdc), causing a linear increase in current through L2. When the transistor is turned off, the inductor current continues to flow but has to take the alternate path through CR3, a high-speed switching diode. Therefore, the collector voltage is one diode drop below zero volts, reversing the polarity of the voltage impressed across L2 and causing the current through L2 to linearly decrease. The output voltage is compared to the reference triangle wave by comparator U1B. If the output voltage is at or below the minimum voltage of the triangle, Q4 will be turned on 100% of the time. Conversely, if the output voltage is above the maximum voltage of the reference triangle, Q4 will be continuously off. In operation, a steady state is reached with the output voltage at a point such that the duty cycle is correct for the established voltage. Any required duty cycle from 5% to 100% can be obtained with the feedback (output, in the case of the +5 Vdc supply) within 100 millivolts of the reference value. The duty cycle will be approximately the ratio of output to input voltage. Note that the loop gain and, therefore, the regulation is established by the peak-to-peak voltage of the reference triangle; the higher this amplitude, the lower the loop gain.

Current limiting action is effected by Q1 and Q4. The peak input current, which is equal to the output current, flows through R2. When the voltage drop across R2 is sufficient to turn on Q1, the collector current from Q1 charges C2 to a voltage which adds to the feedback voltage. The comparator sees a higher feedback voltage and lowers the duty cycle to limit the output current to a safe value.

The +8 Vdc supply operates in a similar manner except that the output voltage is attenuated by a factor of 5/8 to cause the feedback voltage at the comparator to be +5 Vdc when the output is at +8 Vdc. The comparator is provided with open collector outputs. Removing power from the comparator, therefore, removes base drive from the switching transistors and shuts down the supplies.